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The Dangerously Venomous Snakes of the Philippine Archipelago

with Identification Keys and Species Accounts

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Illustrations by Emily Eng and Michael Garfield

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FIGURE 2. *Tropidolaemus subannulatus*
Photo by Cameron D. Siler

The Dangerously Venomous Snakes of the Philippine Archipelago

INTRODUCTION

No fewer than 33 species of dangerously venomous snakes inhabit the Philippine Islands and the surrounding coastal waters (41, if one includes eight sea snakes that have yet to be found in Philippine coastal waters but are likely to occur there). Of the possible 41 species, 26 are sea snakes and except for two, *Laticauda colubrina* and *L. laticaudata*, none voluntarily come onto land (although some sea snakes may wash ashore during severe weather). The remaining 15 species are terrestrial living in various habitats on land and in freshwater. Several terrestrial species, such as *Tropidolaemus* [formerly *Trimeresurus*] *subannulatus* [formerly *wagleri*], favor arboreal habitats and seldom descend to the ground. All terrestrial species can swim, and some regularly occur near human habitations, in agricultural areas, and typically around sources of water such as flooded rice fields, rivers, and streams.

Two families of dangerously venomous snakes are represented in the Philippine herpetofauna, Elapidae (including sea snakes [subfamilies Hydrophiinae and Laticaudinae]), and Viperidae. A number of mildly venomous snakes occur in the archipelago as well, and most are members of the highly diverse snake family Colubridae; these include the rear-fanged Asian vine-snakes (*Ahaetulla*), cat-eyed snakes (*Boiga*), mock viper (*Psammodynastes*), and two aquatic and semi-aquatic snakes (*Enhydris*, *Cerberus*). How dangerous any of these are to humans is still an open matter for research. Several of the supposedly non-venomous Asian colubrids have been shown to have toxic salivas, and some can be considered mildly, if not dangerously, venomous. Some non-Philippine watersnakes (selected species of *Tropidonophis* and *Rhabdophis*) have been shown to be life threatening to humans but to date, in the Philippines none of these genera have been shown to be dangerous. What we do know is that we often underestimate the severity of many snakebites of both juvenile dangerously venomous and supposedly non-dangerously venomous snakes. Yet, bites of just such animals have been implicated in the deaths of several knowledgeable professional herpetologists, notably Karl Patterson Schmidt who, in 1957 at the age of 67, was bitten by a juvenile boomslang (*Dispholidus typus*), an African rear-fanged snake, and died a day later; in 1965, Fred Shannon, M.D., was bitten by *Crotalus scutellatus*, and a few years later, in 1975, Robert Mertens, was bitten by another African rear-fanged snake, *Thelotornis capensis*, and both died as a result of the bites. And, most recently, in 2001, Joseph Slowinski, at the age of 38, was bitten by a 30 cm long juvenile krait, *Bungarus wanghaotingi*, and died within 48 hours.

FIGURE 1. Looks can be deceiving. A field colleague recently picked up and photographed this innocent-looking snake in the belief it was a non-venomous species of *Calamaria*. It is, in fact, a coral snake, of the genus *Calliophis*. Photo by N. Antoque.

At this point we emphasize that extreme care should be exercised when handling any snake, even those that are supposedly non-venomous. It is not always possible to tell the difference between venomous and non-venomous species without careful inspection. In the Philippines, for instance, several snakes are black with white bandings; among these are *Lycodon subcinctus*, *Calamaria lumbricoidea*, juveniles of several species of *Oxyrhabdion*, *Oligodon*, and *Chrysopelea*, as well as the six species of venomous snakes that are referred to the genera *Hemibungarus* and *Calliophis*. The snakes of the first group are non-venomous, the latter two,

Hemibungarus and *Calliophis*, dangerously venomous. The only definitive way to know whether a dark and light banded snake is a venomous or non-venomous species is to examine the side of the head just in front of the eye to see if a loreal scale (see fig. on p. 480) is present. If it is absent, the snake may well be a venomous species. In the illustrated keys that follow, these and other defining characters are clearly noted.

With respect to the treatment of snake-bites, again it cannot be overstated that all bites should be taken seriously. It is true that a large percentage of bites, even by dangerously venomous snakes, are "dry bites," that is bites in which no envenomation occurs. Because it is not always possible to know immediately following a bite whether or not envenomation has occurred, it is imperative to seek appropriate medical treatment as soon as possible. More complete instructions are available in other publications, several of which are given in the bibliography (see in particular WHO 1999 and Lewin [this volume]).

The snake fauna of the Philippines is reasonably well known, although there are areas of the country that have not been thoroughy investigated, especially parts of Luzon, Mindanao, and Palawan. It should be emphasized that precise knowledge of the kinds of venomous snakes present is imperative if one is going to receive effective medical treatment for a snakebite. For instance, in the Philippines, heretofore, only one species with three subspecies of the Philippine cobra was recognized, *Naja naja*, but extensive work by investigators demonstrated that in reality the three subspecies are quite distinct and are now recognized as full species. However, in the Philippines, only one antivenin is manufactured and readily available, for *Naja philippinensis*. The importance of this can be appreciated when one considers that to treat a snakebite one must often use species-specific antivenom in as much as the antivenom used to treat one kind of snakebite may not work for the bites of other species. Whether the species-specific antivenom for the Philippine cobra, *Naja philippinensis*, works for other cobra snakebites is not known.

The Philippines has a highly diverse fauna. And as a result of recent surveys, starting in the 1950s by the late Walter C. Brown of Menlo College, California, and and his colleague Angel Alcala, then at Silliman University, Dumaguete, and thanks to recent field work throughout the archipelago, knowledge of the faunal diversity has improved greatly. It is hoped that this contribution will enable those engaged in the study of the fauna in the field and the laboratory to recognize more readily the most dangerous components of that fauna.

The present work represents an effort with a single purpose, to aid in the identification of venomous snakes of the Philippines. Thus, we have made no attempt to provide inclusive synonymies, which are available in several of the works we cite, namely, Taylor (1922a), Leviton (1964a, 1964b), Golay et al. (1993), McDiarmid, Campbell and Touré (1999), and David and Ineich (1999). Where necessary, we provide additional references. DESCRIPTIONS of individual species are intentionally brief, but they include the data necessary for confirmation of identifications. The data for SIZE refer to known maximum lengths recorded for the species; when available, total and tail lengths for males and females are given separately. In the statements on DISTRIBUTION, we list only the country for non-Philippine localities and, where known, to Island and/or Province within the Philippines (see map, p. 492).

We accept names for all of the dangerously venomous snake species in the Philippines that represent the most current taxonomic arrangements, although with respect to sea snakes we have followed Sanders et al. (2013) (see also Pyron et al. 2013) in the use of generic assignments of species and Rasmussen et al. (2011) for subfamily assignments. We provide a brief table of equivalencies (p. 487) so that those familiar with older names can quickly locate the species of interest. For instance, in the Philippines, snakes formerly referred to collectively as *Trimeresurus wagleri*, have been assigned to two different species under the genus name *Tropidolaemus* (i.e., *T. philippensis*

and *T. subannulatus*); the annulated or barred coral snake, *Calliophis calligaster*, is now placed in the genus *Hemibungarus*, whereas the banded coral snake, *Maticora intestinalis*, is referred to as *Calliophis intestinalis*. In addition, in recent years, the pit vipers usually referred to the genus *Trimeresurus* have been subjected to intense scrutiny and at times have been reassigned to several genera, *Trimeresurus*, *Parias*, and, as already noted, *Tropidolaemus*. At the time of the writing of this report, the species of pit vipers assigned to the nominal genus *Parias*, have been returned to the genus *Trimeresurus* (e.g., *T. flavomaculatus*, *T. mcgregori*, and *T. schultzei*); however, some researchers recognize *Parias* as a subgenus of *Trimeresurus*, and we have adopted that assignment here, whereas *Tropidolaemus* is still valid as a distinct genus. These changes, though frequently confusing to the non-specialist, often represent significant advances to our understanding of the relationships and are important in leading to more effective treatment of snakebites by allowing for the selection and administration of appropriate species-specific antivenoms.

Lastly, we emphasize that whereas we believe all snakes should be treated with care, venomous or not, snakes are also highly beneficial to the ecosystem and should not be wantonly destroyed because of fear. The vast majority of the Philippines' 180+ species of snakes are not dangerous to humans.

An early version of this publication titled "Keys to the dangerously venomous terrestrial snakes of the Philippines" was published in the *Silliman Journal* (Leviton 1961). That publication was followed by Angel Alcala's 1986 treatment of the venomous snakes of the Philippines in volume X, *Amphibians and Reptiles*, in the *Guide to Philippine Flora and Fauna*. Since these publications appeared, additional new information from both field and laboratory research has come to light. Indeed, a number of groups in Europe and the United States are actively engaged in research aimed at clarifying the taxonomy of the viperid genera *Trimeresurus* and *Tropidolaemus*, as well as the elapid snakes in the genera *Calliophis* and *Hemibungarus* and the sea snakes. As a result, we expect that the classification of the venomous snakes presented here will continue to change (see Bibliography for references, especially for authors David, Ineich, and Vogel, Rasmussen et al., Thorpe, Maholtra, and Wüster).

ACKNOWLEDGMENTS

The authors express their profound appreciation to Harold Voris, Doug Lin, and John Tashjian, who are responsible for several of the photographs that are reproduced here. Please note that in those figure legends where the words "Photo by" appear, copyright ownership of the images resides with the individual acknowledged and not the California Academy of Sciences.

We owe a special thanks to our friend and collaborator A. C. Diesmos (National Museum of the Philippines) for his continued support, past companionship in the field, for the use of photographs reproduced here, and for the logistical assistance he has generously provided through the years.

And, lest we forget, one of us (AEL) wants to express his appreciation again to the staff of the National Museum of Natural History, specifically George Zug, Addison Wynn, and Kenneth Tighe, for their ongoing assistance in locating specimens and providing onsite work space.

Lastly, we thank Dr. Michele L. Aldrich who perused an early version of the manuscript with extraordinary care and made substantive suggestions for improving the overall presentation. We are also indebted to the external reviewers for their thoughtful comments. Dr. George Zug, in particular, suggested a number of changes, most of which we heartily accepted. Having said this, the authors still bear full responsibility for their decisions to accept or reject specific recommendations as well as for errors of commission or omission.

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Alan E. Leviton, *Rafe M. Brown*, and *Cameron D. Siler*
06 January 2014

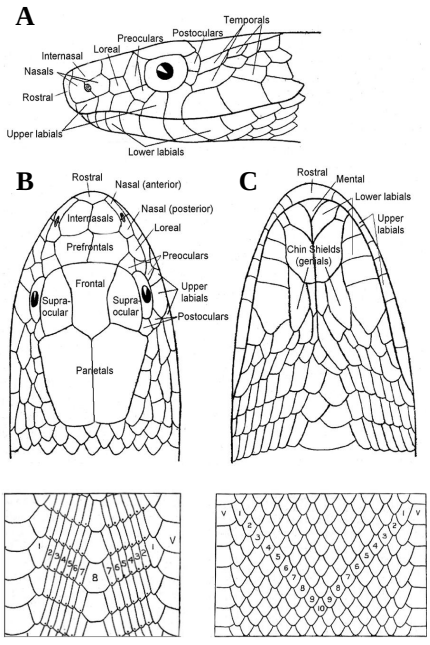
Identification Keys to the Species of Dangerously Venomous Snakes of the Philippine Archipelago

GENERAL NOTE AND TAXONOMIC (NAME) CHANGES: This key has been formulated to accommodate only the dangerously venomous snakes known from the Philippine Islands. It should not be used, even at the generic or familial group levels, to identify venomous snakes from outside the archipelago. Colors mentioned in the keys are based on colors in life; in preservative, colors may be lost or changed, greens turn bluish, reds are lost, and other bright colors become dull. In preparing this key and the species accounts that follow, we have been guided by the latest revisionary studies, but we have also taken a conservative position because of the nature of the animals with which we are working (see below). The section of the key dealing with the sea snakes (couplets 17 et seq.) has been modified from Smith (1926 and 1943 and Rasmussen, Elmberg, Gravlund, and Ineich 2011). Furthermore, we have culled from the literature and adopted the most recent phylogenetic arrangement for the genera of viviparous sea snakes, notably that of Sanders et al. 2013, so that many heretofore familar generic names, such as *Enhydrina*, *Lapemis*, and *Pelamis*, and their included species, have been referred to the genus *Hydrophis*.

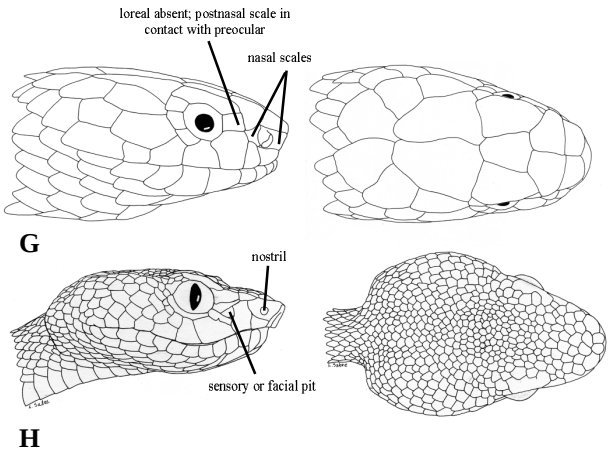
Also, we have, rather arbitrarily, chosen to accord all recognizably distinct allopatric subspecies full species status rather than get embroiled in arguments of why raise one subspecies to full species status but retain another as a subspecies, though both can be readily, though differentially, diagnosed taxonomically. Arguments as to what constititues a biological "species" versus "subspecies" are most often not fruitful and usually based on arbitrary assessments by a given worker on just how "important" a character or character state is in inferring the "closeness" of biological affinities, i.e., the genealogical relationships among the parties.

As we have already mentioned (pp. 472–473), in recent years the most significant nomenclatural changes have been in the allocation of species among genera of venomous snakes. Thus, we hasten to emphasize, many of these changes are not to be taken lightly inasmuch as they reflect important changes in our understanding of the relationships among these venomous snake species and are highly relevant because of the significant medical implications, vis-a-vis the production and use of antivenins in the treatment of snakebites.

Also, please note, many of the images have been provided by colleagues as a courtesy for the express use of members of the Hearst Philippine Expedition participants; the images are owned and copyrighted by the donors and must not be copied or otherwise distributed.

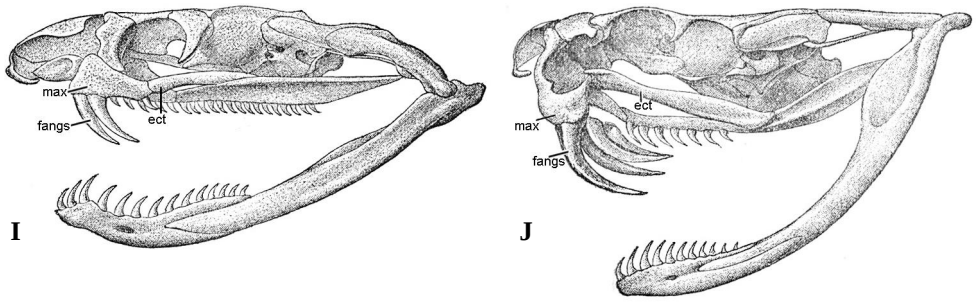


Diagrams of head and body scalation in a typical snake. *Head scales*: (A) lateral, (B) dorsal, and (C) Ventral views.
Body scale patterns and how best to count scale rows. Body scales arranged in (D) oblique rows, and (E) parallel rows.
Diagrams modified from Smith (1943)



G. Lateral and dorsal views of the head of a king cobra, *Ophiophagus hannah.* Note in particular the absence of the loreal scale between the postnasal and the preocular scales. This is characteristic of all elapine snakes, but the absence must be used with care because a number of non-venomous colubrine snakes also lack the loreal.

H. Lateral and dorsal view of a typical Philippine viperine snake, *Trimeresurus* (*Parias*) *flavomaculatus.* Note the position of the sensory pit located on the side of the head between the nostril and the eye.



Diagrams of skulls of elapine (*Naja naja*) (I) and crotaline viper (*Crotalus horridus*) (J) skulls.
(I) maxilla is attached to ectopterygoid and cannot rotate; small post-fang maxillary teeth usually behind venom delivery fangs; (J) Maxillary bone small, rotates against ectopterygoid; no teeth behind venom delivery fangs.
Diagrams from Boulenger (1893, 3:373 and 3:518)
(max = maxillary bone; ect = ectoptygeroid bone)

FIGURES 3A–J. Diagrams of diagnostic scale and dental characters of Philippine snakes.

1a. Pupil of eye round; loreal scale absent (Fig. 4); venom fangs short, permanently erect; maxillary bone elongate, usually with several small teeth behind front fangs (Family Elapidae, including cobras, coral snakes, and sea snakes) (see Fig. 3I). 2

1b. Pupil of eye vertically elliptical (Fig. 5A); loreal scale absent; upper surface of head either covered by small scales (Fig. 5B) or large, symmetrical scales; a deep sensory pit present immediately behind the nostril (Fig. 5A); venom fangs variable in length, fixed to a short moveable maxillary bone that allows for rotation of the fangs backward when the mouth is closed; no teeth behind fangs (Family Viperidae) (see Fig. 3J). 12

2a. Tail flattened laterally, oar-like (Fig. 6A) (sea snakes). 16

2b. Tail rounded, tapering (Fig. 6B) (terrestrial snakes). 3

3a. Scales in 13–15 longitudinal rows at midbody; scales on sides of body variable, in either oblique or parallel rows (Figs. 3D, 3E, 8A, and 8B). 4

3b. Scales in 17–25 longitudinal rows at midbody; scales on sides of body in oblique rows [Fig. 3D, also Fig. 8A for *Ophiophagus*] (Genus *Naja*). 10

4a. Scales on sides of body in oblique rows (Figs. 3D, 8A); number of scales on posterior third of body at least two less than on anterior third (Balabac, Jolo, Luzon, Mindanao, Mindoro, Negros, Panay, Palawan, Polillo). . . . . *Ophiophagus hannah* (Fig. 7A)

4b. Scales on sides of body in parallel rows (Figs. 3E, 8B); number of scales on posterior third of body equal to number on anterior third. 5

5a. Scales in 15 longitudinal rows at midhody (Genus *Hemibungarus*). 6

5b. Scales in 13 longitudinal rows at midbody (Genus *Calliophis*). 8

6a. Black rings on dorsum of body not divided by narrow white annuli; temporal region heavily pigmented with melanin; white annuli on dorsum usually less than 60. 7

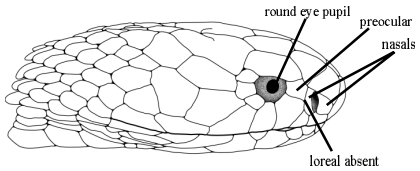
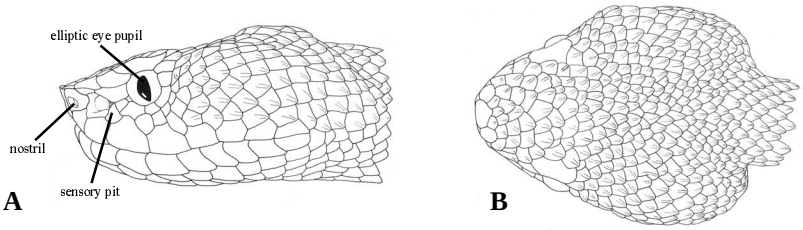
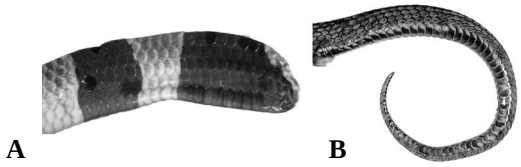


FIGURE 4. Pupil of eye of *Naja philippinensis*; loreal scale absent.



FIGURES 5A–B. *Tropidolaemus subannulatus*: (A) Lateral view of head (B) Dorsal view of head.



FIGURES 6A–B. Tails of sea snakes (A. laterally compressed, paddle-shaped) and terrestrial snakes (B. not compressed, rounded and tapering toward tip).

6b. Black rings on dorsum of body divided by narrow white annuli; temporal region not heavily pigmented with melanin; white annuli on dorsum usually more than 60; ventral shields: (♂) 197–216, (♀) 218–227 (Cebu, Negros, Panay). . . . . *Hemibungarus gemianulis*

7a. Ventral shields: (♂) 223–233; (♀) 252–259 (Luzon). . . . . *Hemibungarus calligaster* (Fig. 9)

7b. Ventral shields: (♂) 206 (two specimens) (Polillo and adjacent Aurora Prov., Luzon). . . . . *Hemibungarus mcclungi*

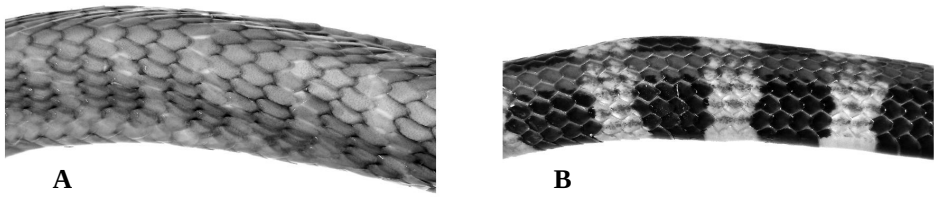
8a. Black crossbars on venter do not come in contact with black of sides; a distinct white line present on sides occupying entire first scale row or parts of first and second rows (Balabac, Busuanga, Culion, Palawan). . . . . *Calliophis bilineata*

8b. Black crossbars on venter contact black of sides; no distinct white line along outer scale rows 9

9a. Cream colored crossbars on venter do not extend on to side of body above first scale row (Jolo) . . . . . *Calliophis suluensis*

9b. Cream colored crossbars on venter extend onto side of body, often to fourth scale row (Mindanao, Samar). . . . . *Calliophis philippina* (Fig. 10)

FIGURES 7A–B. Juneiles of (A) *Ophiophagus hannah*. and (B) *Naja philippinensis*.
Photos.courtesy of (A) John Tashjian and (B) Markus Oulehla



FIGURES 8A–B. Scales on sides of body: (A) slanting downward [oblique] (*Ophiophagus hannah*); (B) horizontal [parallel] (*Hemibungarus calligaster*).

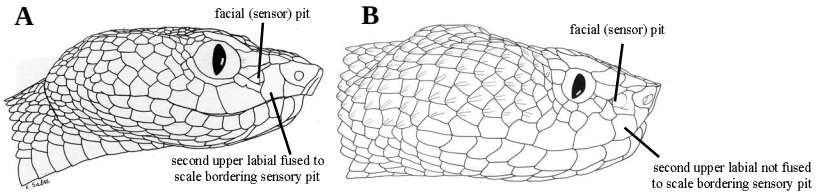
FIGURE 9. *Hemibungarus calligaster*.
Photo by Rafe Brown.

FIGURE 10. *Calliophis philippina*.
Photo by Rafe Bown.

10a. Scales at midbody in 17–19 longitudinal rows; ground color above black or dark brown. . . 11
10b. Scales at midbody in 21–23 longitudinal rows; above color uniform light brown or olive; ventrals 180–196 (Catanduanes, Luzon, Mindoro). . . . . *Naja philippinensis* (Fig. 7B)

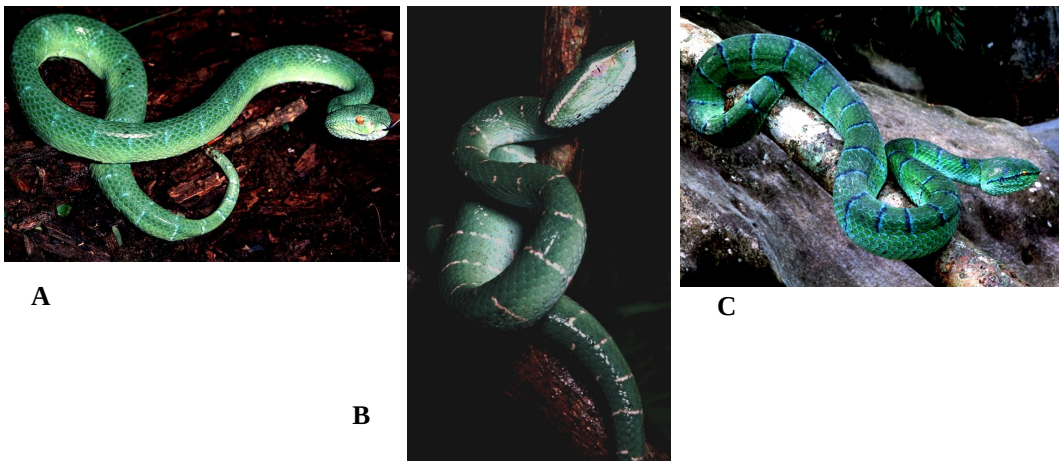
11a. A few anterior ventrals light yellow followed by band of black that gradually fades posteriorly; ventrals 162–178 (Bohol, Leyte, Mindanao, Samar). . . . . *Naja samarensis*
11b. Venter dark or light but without a distinctive black band on anterior portion; ventrals 178–189 (Culion, Palawan). . . . . *Naja sumatrana*

12a. Scales on head and chin smooth; second upper labial fused to scale forming anterior border of facial pit (Fig. 11A). 14
l2b. Scales on head and chin strongly keeled; second upper labial separated from scale forming anterior border of facial pit (Fig. 11B). 13



FIGURES 11A–B. Lateral view of heads of (A) *Trimeresurus* (*Parias*) *flavomaculatus* and (B) *Tropidolaemus subannulatus.*

13a. Scale rows at midbody, (♂) 21–23 , (♀) 21–29; internasals separated by 2 (rarely 1) scales, never in contact; 3rd upper labial usually separated from subocular by 1 or 2 scales; scales on snout along a straight line from rostral to level of supraoculars, (♂) 4–7, (♀) 5–8; scales on dorsum of head on a line between supraoculars 9–16; color variable, shades of green, blue or green and blue in females, green in males but blue in some Negros populations; crossbands around body blue and white, red and white, or blue, red and white; postocular stripe in females variable, in males white or red, and red in juveniles; ventrals (♂) 128–148, (♀) 127–147; subcaudals (♂) 45–53, (♀) 40–54 (Balabac, Basilan, Bohol, Dinagat, Jolo, Leyte, Luzon, Mindanao, Negros, Palawan, Panay, Samar, Sibutu, Tumindao) . . . . . *Tropidolaemus subannulatus* (Fig. 12A–C)



FIGURES 12A–C. *Tropidolaemus subannulatus*: (A) Luzon, female; (B) Luzon, male; (C) Negros, female. Photos by Rafe Brown.

13b. Scale rows at midbody 18–19; internasals separated by 1 or 2 scales, never in contact; 3rd upper labial usually in contact with subocular or rarely separated by only 1 scale; scales on snout along a straight line from rostral to level of supraoculars (♂) 4–5, (♀) 5; scales on dorsum of head on line between supraoculars 6–8; color green-turquoise background color in males, green in females; postocular stripe in black, rarely white, in both females and males; ventrals (♂) 131–135, (♀) 129; subcaudals (M) 45–46, (♀) 44 (Leyte, Mindanao, Samar). . . . . *Tropidolaemus philippensis*

14a. Tail not distinctly differentiated from body by color; hemipenes without spines. 15

14b. Tail distinctly differentiated from body by color; hemipenes spinose (Balabac, Palawan). . . . . *Trimeresurus* (*Parias*) *schultzei* (Fig. 13)

15a. Dorsal color lacks dark pigments except for a scattering of dark dorsal blotches; yellow in life (white in alcohol) (Batan Island). . . . . *Trimeresurus* (*Parias*) *mcgregori* (Fig. 14)

15b. Dorsal color with dark pigments present, usually blue green, green or dark blue gray (Camiguin, Jolo, Luzon, Mindanao, Siquijor). . . . . *Trimeresurus* (*Parias*) *flavomaculatus* (Fig. 15)

FIGURE 13. *Trimeresurus* (*Parias*) *schultzei.* Photo by Rafe Brown.

FIGURE 14. *Trimeresurus* (*Parias*) *mcgregori.* Photo by Rafe Brown.

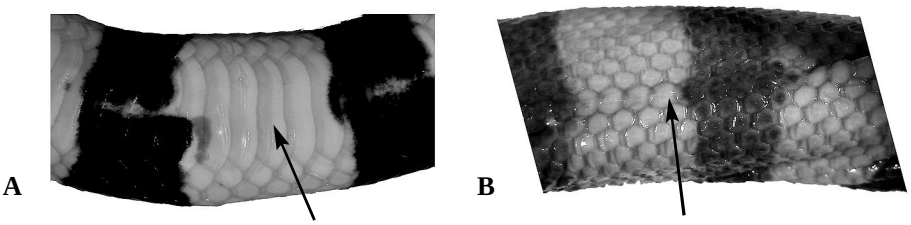
FIGURES 15A–B. Variation in color pattern in *Trimeresurus* (*Parias*) *flavomaculatus.* Photos by Rafe Brown.

Seasnakes

(N.B. Several species included in this section of the keys have yet to be reported from Philippine waters but have been found in neighboring areas, off the coast of northern Borneo and/or elsewhere in the South China Sea region [indicated by boldface type]). Also, recent phylogenetic studies of the sea snake genus *Hydrophis* and allied genera, have resulted in major changes in the the generic assignment of species. Those changes are indicated here by enclosing formerly recognized genera in brackets [ ] following the now current name for the species, e.g., *Hydrophis curtus*, formerly *Lapemis curtus*, is shown below as *Hydrophis* [*Lapemis*] *curtus*.

16a. Ventral scales large, one-third to more than one-half the width of the body (Fig. 16A); nostrils lateral or superior, nasal scales in contact or separated separated by internasals. 17

16b. Ventral scales small, less than one-fourth width of body, often smaller than or at least not larger than adjacent body scales (Fig. 16B); nostrils variable, internasal scales absent, nasal scales in contact with one another. 20

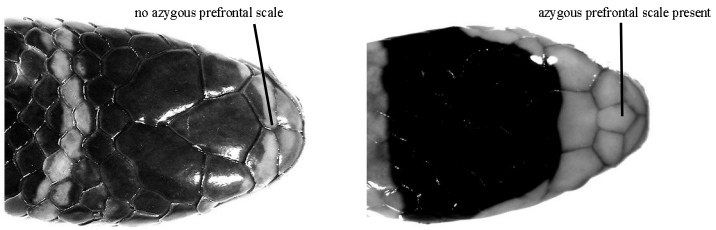


FIGURES 16A–B. Ventral scales in sea snakes: (A) large ventral scales in *Laticauda* (*Laticauda colubrina*); (B) small ventral scales in *Hydrophis* (*Hydrophis atriceps*) and other sea snakes.

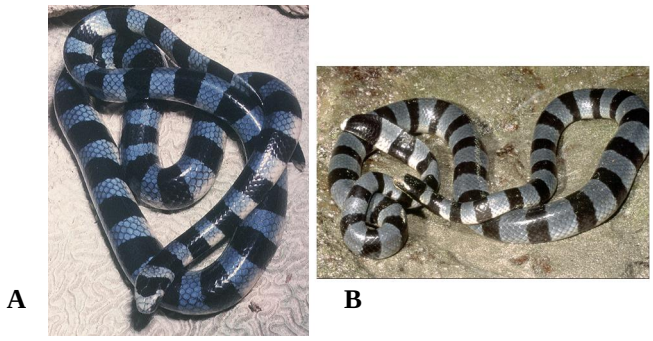
17a. Nostrils lateral; nasals separated by internasals. 18

17b. Nostrils superior; nasals in contact with one another. . . . . ***Aipysurus eydouxii***

18a. Scales in 19 longitudinal rows at midbody; no azygous prefrontal scale (Fig. 17A); ventrals 225–243. . . . . *Laticauda laticaudata* (Fig. 18A)



FIGURES 17A–B. Azygous prefrontal scale: (A) absent in *Laticauda laticaudata*; (B) present in *Laticauda colubrina.*



FIGURES 18A–B. (A) *Laticauda laticaudata*. Photo courtesy John Tashjian; (B) *Laticauda colubrina.* Photo by Dong Lin.

18b. Scales in 21–25 longitudinal rows at midbody; an azygous prefrontal scale usually present (Fig. 17B). 19

19a. Rostral not divided; upper lip yellow; ventrals 213–245. . . . . *Laticauda colubrina* (Fig. 18B)

19b. Rostral divided horizontally; upper lip brown; ventrals 195–205; 30–42 bands on body. . . . . *Laticauda semifasciata*

20a. More than 72 scale rows around midbody. . . . . ***Hydrophis*** [***Kolpophis***] ***annandalei***

20b. Fewer than 72 scale rows around midbody. 21

21a. Rostral scale fragmented into 4 or 5 smaller scales; dorsal head scales with thickened edges . . . . . ***Hydrophis*** [***Thalassophis***] ***anomalus***

21b. Not as above. 22

22a. Three supralabials only, second very elongate. . . . . *Emydocephalus annulatus*

22b. Not as above. 23

23a. Ventrals much broader anteriorly than posteriorly. . . . . ***Hydrophis*** [***Praescutata***] ***viperina***

23b. Ventrals uniformily small. 24

24a. Ventral scales small but distinct throughout, undivided by a median groove (Fig. 19B) or, if divided posteriorly (Fig. 19C), the two halves either apposed or alternating with one another, head very small and front half of body long and very slender. 25

24b. Ventral scales, if distinct, then either divided by a median groove (Fig. 19C) or smaller than adjacent body scales (Fig. 19A). 38

25a. Not more than 23 scales aboud the thickest part of body. . . . . ***Hydrophis*** [***Kerilia***] ***jerdoni***

25b. At least 25 or more scales around thickest part of body. 26

26a. Head scales regular, usually entire (Fig. 20A); nasal scales in contact with one another; preocular present. 27

26b. Head scales, especially frontal and parietal, more or less fragmented (Fig. 20B) . . . . . ***Hydrophis*** [***Acalyptophis***] ***peronii***

27a. Mental scale normal (Fig. 21A), not hidden in symphysis grove; ventrals uniform in size; 1–18 maxillary teeth behind fangs. 28

27b. Mental scale elongate, partially hidden in groove in symphysis (Fig. 21B); ventrals uniform in size; 3–5 maxillary teeth behind fangs . . . . . ***Hydrophis*** [***Enhydrina***] ***schistosus*** (Fig. 22)

28a. Scales on thickest part of body hexagonal or quadrangular in shape, weakly imbricate or juxtaposed (Fig. 23A); 8–18 maxillary teeth behind fangs. 29

28b. Scales on thickest part of body with rounded or bluntly pointed tips, distinctly or weakly imbricate (Fig. 23B); 1–8 maxillary teeth behind fangs. 32

29a. Head very small, body long and very slender anteriorly (Fig. 24A); 5–6 maxillary teeth behind front fangs. 30

29b. Head not distinctly reduced, body not particularly slender anteriorly (Fig. 24B); head and body grayish above, white below; ventrals 195–281; 8–18 maxillary teeth behind fangs. . . . 31

30a. Head black with yellowish spots; body grayish above, white below; scales in 25–30 longitudinal rows around neck, 39–49 around thickest part of body; ventrals 323–452. . . . . *Hydrophis atriceps*

30b. Head blackish with a curved yellow mark across snout and extending backwards along sides of head and sometimes a connecting yellow band or two across frontal and parietal region, body greyish above, yellowish while below, with 60–80 dark grey bands, usually encircling body anteriorly; markings often lost in older adults; 37–45 scales around midbody; ventrals 328–414. . . . . ***Hydrophis brookii***

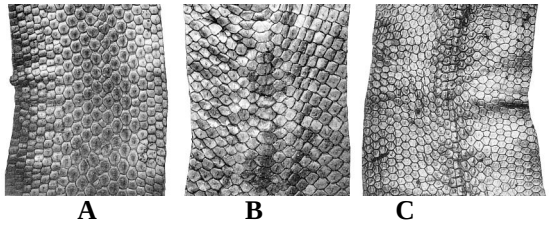
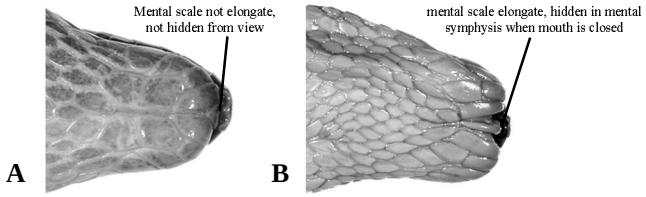


FIGURE 19. Ventral scales in hydrophiine sea snakes (adapted from Smith, 1926, pls. I and II). (A) undivided and indistinguishable from adjacent scales (*Hydrophis* [*Lapemis*] *curtus*); (B) usually distinguishable from adjacent scales (*Hydrophis cyanocinctus*); (C) divided by a longitudinal groove (*Hydrophis gracilis*)

FIGURES 20A–C. Scales on dorsum of head: (A) scales unfragmented (*Hydrophis* [*Enhydrina*] *schistosus*) and (B) (*Hydrophis cyanocinctus*); (C) frontal and parietal head scales fragmented (*Hydrophis* [*Acalyptophis*] *peronii)*.



FIGURES 21A–B. Mental scale: (A) normal, neither elongate nor partially hidden from view in mental symphysis (*Hydrophis*); (B) elongate mental scale partially hidden in mental symphysis when mouth is closed (*Hydrophis* [*Enhydrina*] *schistosus*)

FIGURE 22. *Hydrophis* [*Enhydrina*] *schistosus.* Photo courtesy of Harold Voris.

31a. 26–36 dark middorsal blotches or bands on body; anteriorly interspaces between dorsal dark body bands more than 2 scale rows wide; 4–6 dark bands on tail; 37–45 scale rows around neck; ventral scales 258–306; 9–12 maxillary teeth behind front fangs. . . ***Hydrophis lamberti***

31b. 39–45 dark middorsal blotches or bands on body; anteriorly interspaces between dorsal dark body blotches or bands less than 2 scale rows wide; 8–11 dark bands on tail; 31–39 scale rows around neck; ventral scales 224–294; 9–12 maxillary teeth behind front fangs. . . . . *Hydrophis ornatus*

32a. Usually one anterior temporal (Fig. 25A); 25–31 scale rows around neck; 6–8 upper labials 35

32b. Usually two anterior temporals (Fig. 25B); 31–43 scale rows around neck. 33

33a. 14–18 maxillary teeth behind front fangs; 31–43 scales around neck, 38–54 around midbody; ventrals 253–334. . . . . *Hydrophis caerulescens*

33b. Less than 14 maxillary teeth behind front fangs (usually 10 or fewer). 34

34a. Head in adult olive or yellowish (in young, head may be black or dark olive); black ventral stripe often present but less distinct in older adults; dorsal portions of black body annuli persist even in older adults; ventrals 290–390. . . . . *Hydrophis cyanocinctus* (Figs. 26A–B)

34b. Head in adult black; body black with 50 to 60 narrow whitish bands or annuli; ventrals usually black; ventrals 314–356 (restricted to Lake Taal [Bombon], Luzon). . . *Hydrophis semperi*

35a. Usually 5 upper labials, rarely 6; 22–27 scale rows around neck; ventrals 360–415; one anterior temporal. . . . . ***Hydrophis klossi***

35b. Usually 6 or 7 upper labials, rarely 5; 23–31 scale rows around neck, usually greater than 24; one anterior temporal, sometimes divided into two superimposed scales. 36

36a. Longitudinal rows of scales increases by 4–8 rows from neck to midbody (25–29[neck]/33–38[midbody] + 4–8 increase in rows) [1]. . . . . *Hydrophis spiralis* (Figs. 26C–D)

36b. Longitudinal rows of scales increases by 8–18 rows from neck to midbody; body greatly compressed posteriorly. 37

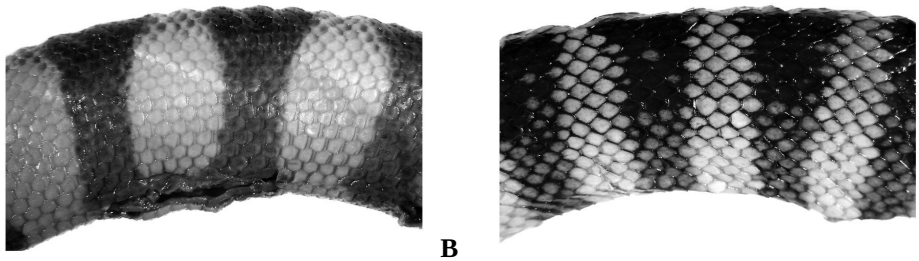
37a. Head black with yellow markings; head small, body long and slender anteriorly, compressed posteriorly; 40–55 dark bands on body; 23–27 scale rows around neck, 33–41 around midbody; 6–8 maxillary teeth behind front fangs. . . . . ***Hydrophis melanocephalus***

37b. Head black in young with or without a yellow curved mark above, greyish, olive, or yellowish in adult; head moderate, body elongate, compressed posteriorly; 25–31 scale rows around neck, 37–45 around midbody; 60–80 dark bands on body, fading in adults; 4–5 maxillary teeth behind front fangs. . . . . *Hydrophis belcheri*

38a. Midbody scales in 25–43 rows around body; dorsal scales hexagonal, juxtaposed. 39

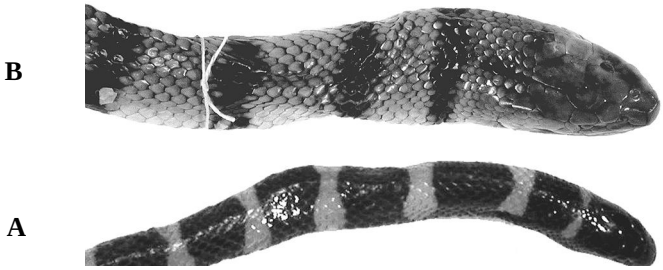
38b. Midbody scales in 47–67 rows around body; dorsal scales juxtaposed, or imbricate. 40

39a. Head small, anteriorly body elongate and narrow; scale rows around neck 17–23; scales

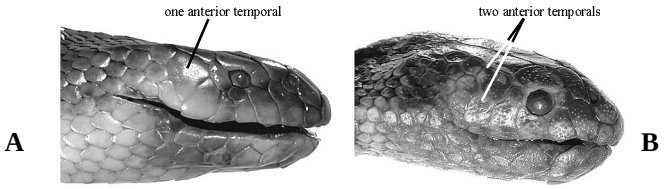


FIGURES 23A–B. Scales on thickest part of body: (A) hexagonal or quadrangular in shape (*Hydrophis atriceps*); (B) scales rounded or with bluntly pointed tips (*Hydrophis cyanocinctus*).

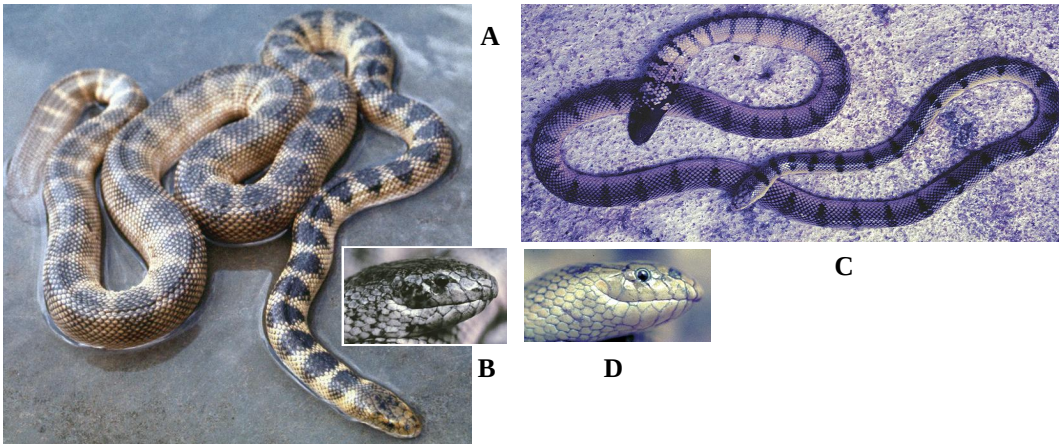
[1] After Smith (1926): "represents the number of scale rows on the neck and body, and the increase in the number of scale rows from neck to midbody."



FIGURES 24A–B. Head and body dimensions: (A) head and anterior fourth of body slender (*Hydrophis atriceps*); (B) head and anterior portion of body not distinctly narrowed (*Hydrophis ornatus*)



FIGURES 25A–B. Anterior temporal scales: (A) one anterior temporal scale (*Hydrophis spiralis*); (B) two anterior temporals scales (*Hydrophis cyanocinctus*).



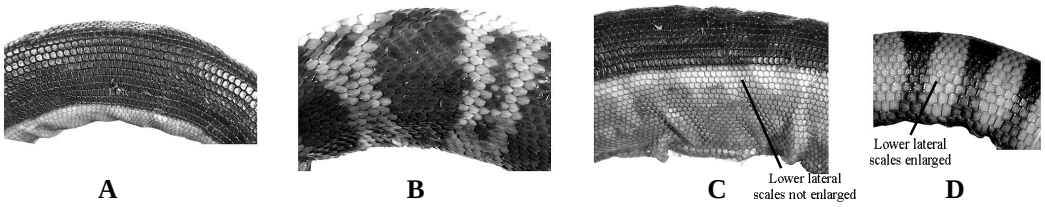
FIGURES 26A–D. (A–B) *Hydrophis cyanocinctus*; (C–D) *Hydrophis spiralis.* Photos courtesy of Harold Voris.

around midbody 30–43; lowermost lateral scale rows slightly larger than upper lateral scales; dorsal scales posteriorly hexagonal, juxtaposed; ventrals usually distinct on anterior fourth of body, entire and broader than adjacent dorsal scales, posteriorly distinctly divided by a median groove. . . . . *Hydrophis gracilis*

39b. Head and neck normal, not narrow (Fig. 28); scale rows around neck 23–31; scale around midbody 25–43; dorsal scales, lowermost lateral scale rows larger than upper lateral scales (Fig. 27D); ventrals usually distinct on anterior fourth of body, posteriorly barely larger than adjacent scales or not enlarged at all, not divided by a longitudinal groove; greenish or olive to gray above, whitish below, 35–55 narrow dark bands, occasionally uniform dark gray; 3–6 maxillary teeth behind each fang. . . . . *Hydrophis* [*Lapemis*] *curtus* (Figs. 28–29)

40a. Dorsal scales pointed, strongly imbricate (Fig. 27B); ventrals in two halves; 6–7 maxillary teeth behind each fang. . . . . *Hydrophis* [*Astrotia*] *stokesii*

40b. Dorsal scales hexagonal, juxtaposed, lowermost lateral scale rows not larger than adjacent upper lateral scales (Fig. 27C); midventral scales, when distinct, divided by a longitudinal groove; bicolored, ordinarily black above, yellow below, with some variation in which yellow extends farther up on the sides and the black is confined to a wide middorsal stripe; sometimes black bars on belly; tail mottled yellow and black; 8–10 maxillary teeth behind front fangs. . . . . *Hydrophis* [*Pelamis*] *platurus* (Fig. 30)



FIGURES 27A–D. Dorsal scales: (A) scales juxtaposted (*Hydrophis* [*Pelamis*] *platurus*); (B) scales imbricate (*Hydrophis* [*Astrotia*] *stokesii*); (C) lowermost 3 or 4 lateral rows not larger than adjacent upper lateral scales (*Hydrophis* [*Pelamis*] *platurus*); (D) lowermost 3 or 4 lateral rows larger than upper lateral scales (*Hydrophis* [*Lapemis*] *curtus* [*hardwicki*])

FIGURE 28. *Hydrophis* [*Lapemis*] *curtus.* Photo courtesy of Harold Voris

FIGURE 29. *Hydrophis* [*Lapemis*] *curtus* [*hardwicki*]. Photo of preserved specimen.

FIGURE 30. *Hydrophis* [*Pelamis*] *platurus.* Photo courtesy of John Tashjian.

Table of taxonomic equivalents for the Philippine venomous snakes

Current name	Also know as
	Terrestrial snakes
Calliophis intestinalis	*Maticora intestinalis*
Calliophis bilineata	*Maticora intestinalis bilineata; Doliophis bilineatus*
Calliophis philippina	*Maticora intestinalis philippina; Doliophis philippinus*
Calliophis suluensis	*Maticora intestinalis suluensis*
Hemibungarus calligaster	*Calliophis calligaster*
Hemibungarus calligaster	*Calliophis calligaster calligaster*
Hemibungarus gemianulis	*Calliophis calligaster gemianulis*
Hemibungarus mcclungi	*Calliophis calligaster mcclungi; Hemibungarus mcclungi*
Naja philippinensis	*Naja naja philippinensis*
Naja samarensis	*Naja naja samarensis*
Naja sumatrana	*Naja naja miolepis*
Ophiophagus hannah	*Naja hannah*
Trimeresurus (*Parias*) *flavomaculatus*	*Trimeresurus flavomaculatus*
Trimeresurus (*Parias*) *flavomaculatus*	*Trimeresurus flavomaculatus flavomaculatus*
Trimeresurus (*Parias*) *flavomaculatus*	*Trimeresurus flavomaculatus halieus; T.* (*Parias*) *halieus; T. halieus*
Trimeresurus (*Parias*) *mcgregori*	*Trimeresurus flavomaculatus mcgregori; T. mcgregori*
Trimeresurus (*Parias*) *schultzei*	*Trimeresurus schultzei*
Tropidolaemus philippensis	*Trimeresurus wagleri philippensis* [*philippinensis*]
Tropidolaemus subannulatus	*Trimeresurus wagleri subannulatus*
	Sea snakes
Aipysurus eydouxii	
Emydocephalis annulatus	
Hydrophis annandalei	*Kolpophis annandalei*
Hydrophis anomalus	*Thalassophis anomalus*
Hydrophis atriceps	*Hydrophis fasciatus* (east of the Straits of Malacca)
Hydrophis belcheri	
Hydrophis brookii	
Hydrophis caerulescens	
Hydrophis curtus	(*Lapemis curtus, Lapemis curtus hardwickii*, also as *L. hardwickii*)
Hydrophis cyanocinctus	*Leioselasma cyanocinctus; Disteira cyanocincta*
Hydrophis gracilis	*Microcephalophis gracilis*
Hydrophis jerdoni	*Kerilia jerdoni*
Hydrophis klossi	
Hydrophis lamberti	(formerly included in *Hydrophis ornatus*)
Hydrophis melanocephalus	*Leioselasma melanocephalus*
Hydrophis ornatus	(also includes *Hydrophis inornatus* from Philippines); *Disteira cyanosoma; Disteira ornata*
Hydrophis peronii	*Acalyptophis peronii*
Hydrophis platurus	*Pelamis platurus; Pelamydrus platurus; Pelamis platura*
Hydrophis schistosus	*Disteira schistosa; Enhydrina schistosa*
Hydrophis semperi	*Leioselasma semperi*
Hydrophis spiralis	*Leioselasma spiralis*
Hydrophis stokesii	*Astrotia stokesii*
Hydrophis viperinus	*Thalassophina viperina; Praescutata viperina*
Laticauda colubrina	
Laticauda laticaudata	
Laticauda semifasciata	*Pseudolaticauda semifasciata*

THE PHILIPPINE ARCHIPELAGO

SPECIES ACCOUNTS OF THE VENOMOUS SNAKES OF THE PHILIPPINE ARCHIPELAGO

Family ELAPIDAE

Subfamily Elapinae

Genus *Calliophis* Gray, 1834

Calliophis Gray, 1834. (Type species: *Aspis intestinalis* Laurenti 1768).

DIAGNOSIS.— Maxilla extends forward beyond palatine; venom fangs followed by a diastema and then by one small, solid tooth; head not distinct from neck; loreal absent; nostril between nasals; eye small, pupil round; body cylindrical, elongate; tail short; scales smooth, in 13 longitudinal rows at midbody; subcaudals paired; venom glands elongate, extending far back into body cavity and terminating in an elongate, club-shaped end; hypapophyses present throughout vertebral column.

GENERAL FEATURES OF PHILIPPINE SPECIES.— Dorsal scales in 13 longitudinal rows except just behind the head where they are in 15 rows; precloacal scale undivided; venter usually with an alternating series of black and light crossbars; head, at least posteriorly, dark.

REMARKS.— The species included here in *Calliophis* were, until recently, placed in the genus *Maticora*. Apart from the reasignment of species formerly referred to *Calliophis*, *Hemibungarus*, and *Maticora* by earlier authors (e.g., Leviton 1964, Toriba 1993, David and Ineich 1999 [*q.v.* for additional references]) and contrary to previous analyses, Slowinski et al. (2001) demonstrated that the type species of *Calliophis* and *Maticora* had been improperly assigned and that the type species of *Calliophis* is *Aspis intestinalis* Laurenti, 1768, by monotypy and whose type locality is Java, Indonesia (restricted by Leviton 1964:529).

Calliophis bilineata Peters, 1881

Two Stripped Coral Snake

Figure 31

Calliophis bilineatus Peters, 1881:109 (type locality: "Pulauan" [=Palawan]).
Maticora intestinalis bilineata, Leviton, 1964:532.

DESCRIPTION.— Black crossbars on venter not in contact with black on sides of body; prefrontals, and usually internasals, rostral and first two upper labials white (in alcohol-preserved specimens); a distinct white line always present on side of body between first and second scale rows, or first scale row completely white; dorsum of tail with two or three black crossbars, otherwise red or cream; ventrals (♂) 232–260, (♀) 266–285; subcaudals (♂) 24–31, (♀) 23–25

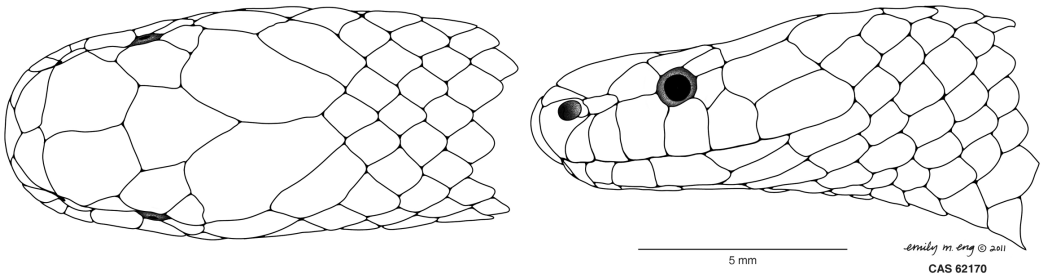


FIGURE 31. *Calliophis bilineata.* Illustrations by Emily M. Eng.

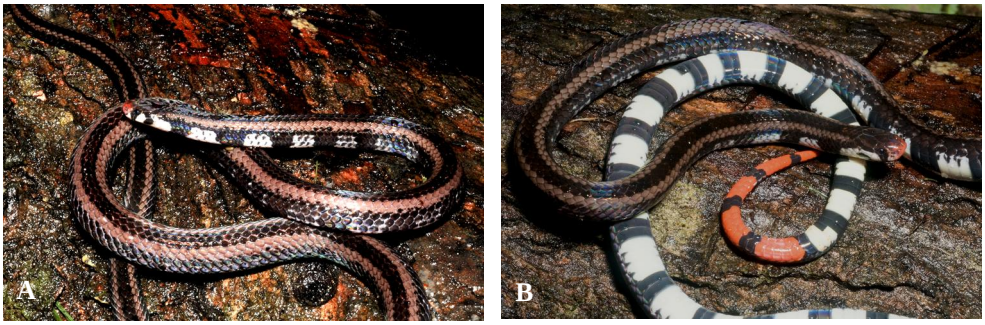
SIZE.— Total length (♂) to 503 mm, (♀) 492 mm; tail length (♂) to 39 mm, (♀) to 28 mm.
DISTRIBUTION.— Endemic to Philippines (Balabac; Busuanga; Culion; Palawan).

Calliophis philippina Günther, 1864

Philippine [banded or striped] Coral Snake
Figures 10, 32A–B

Callophis intestinalis var. *Philippina* Günther, 1864:349 (type locality: Philippine Islands).
Maticora intestinalis philippina, Leviton, 1964:533.

DESCRIPTION.— Black crossbars on venter in contact with black on sides; dorsolateral stripe broad, tan or reddish brown; no distinct white line on sides of body along outer scale row; prefrontals colored as rest of head; cream crossbars on venter extend onto sides of body, often to fourth scale row; ventrals 232–285 (♂ 236–250, ♀ 237–270); subcaudals 21–30 (♂ 25–30, ♀ 21–27); 29–45 black crossbars on venter; 1–4 black crossbars on underside of tail.
SIZE.— Total length (♂) to 625 mm , (♀) 545 mm; tail length (♂) to 47 mm, (♀) to 40 mm.
DISTRIBUTION.— Endemic to Philippines (Mindanao [Prov.: Agusan; Davao; Lanao; Misamis Occidental; Zamboanga]; Samar).



FIGURES 32A–B. *Calliophis philippina* from Western Mindanao Island. Photos by Rafe Brown.

Calliophis suluensis Steindachner, 1891

Sulu Islands Banded Coral Snake

Callophis intentinalis suluensis Steindachner, 1891:295 (Type locality: Sulu Archipelago).
Maticora intestinalis suluensis, Leviton, 1964:535.

DESCRIPTION.— Black crossbars on venter contact black on sides of body; dorsolateral stripe broad, tan or reddish brown; no distinct while line on sides along outer scale rows; prefrontals cream colored (specimen in alcohol), or at least lighter than rest of head; cream-colored crossbars on venter do not extend onto sides of body above first scale row; ventrals 197–218; subcaudals 24–33; 39 black crossbars on venter, 3 on underside of tail.
SIZE.— Total length (♂) to 405 mm, ♀ unknown; tail length (♂) 33 mm, ♀ unknown.
DISTRIBUTION.— Endemic to Philippines (Jolo).

Genus *Hemibungarus* Peters, 1862

Hemibungarus Peters, 1862:638 (Type species: *Elaps calligaster* Wiegmann, 1834).

DIAGNOSIS.— Maxilla extends forward beyond palatine; venom fangs followed by a diastema and then by one small, solid tooth; head not distinct from neck; loreal absent; nostril between nasals; eye small, pupil round; body cylindrical, elongate; tail short; scales smooth, in 13 or 15 lon-

gitudinal rows at midbody; subcaudals paired; venom glands confined to head region; hypapophyses present throughout vertebral column.

GENERAL FEATURES OF PHILIPPINE SPECIES.— Scales in 15 longitudinal rows throughout; 6 upper labials, rarely 7; anterior temporal in contact with 2 upper labials; preocular in contact with nasal; color pattern consists of an alternating series of broad black and red rings that are separated by narrow white annuli (in adults both dorsal and lateral portions of red rings become heavily infused with black pigment).

REMARKS.— See Remarks under *Calliophis* (above).

Hemibungarus calligaster (Weigmann, 1834)

[Annulated or Barred] Philippine Coral Snake

Figures 8B, 9, 33

Elaps calligaster Wiegmann, 1834:253, pl. 20, fig. 2 (Type locality: Manila, Luzon Island).
Hemibungarus calligaster, Taylor, 1922a:269, pl. 33, figs. 1–2, pl. 34, figs. 1–2.— Castoe et al., 2007
Calliophis calligaster calligaster, Leviton, 1964:543.

DESCRIPTION.— Black rings on body not divided by narrow white annuli; narrow white annuli on dorsum of body 44–75; temporal region more or less heavily pigmented with melanin, with a distinct light vertical postocular stripe and a diagonal nuchal chevron bordering the area; ventrals 223–259 (♂ 223–233, ♀ 252–259); subcaudals 16–22 (♂ 17–22, ♀ 13–30).

FIGURE 33. *Hemibungarus calligaster*. Photo by Cameron Siler.

SIZE.— Total length (♂) 515 mm, (♀) 504 mm; tail length (♂) 28 mm, (♀) 28 mm.

DISTRIBUTION.— Endemic to Philippines (Luzon [Prov.: Albay, Bataan, Camarines Sur, Laguna, Quezon, Rizal]; Mindoro).

Hemibungarus gemianulis Peters, 1872

[Double-barred] Philippine Coral Snake

Hemibungarus gemianulis Peters, 1872:587 (Type locality: "Philippine Ids.")
Hemibungarus calligaster (part) Taylor, 1922a:269.
Calliophis calligaster gemianulis, Leviton, 1964:545.

DESCRIPTION.— Black rings on body divided by narrow white annuli; white annuli on dorsum 60–83; temporal region either light (cream or reddish) or very lightly spotted with melanin; ventrals 196–227; subcaudals 15–21.

SIZE.— Total length (♂) 551 mm, (♀) 478 mm; tail length (♂) 32 mm, (♀) 28 mm.

DISTRIBUTION.— Endemic to Philippines (Cebu; Negros; Panay).

Hemibungarus mcclungi Taylor, 1922

McClung's Philippine Coral Snake

Hemibungarus mcclungi Taylor, 1922a:272, pl. 33, pl. 34, figs. 3–4 (Type locality: Polillo).
Calliophis calligaster mcclungi, Leviton, 1964:547.

DESCRIPTION.— Black rings on body not divided above by narrow white annuli; narrow white annuli on body 46 (but white often obscured by melanin pigmentation); temporal region pigmented; ventrals 206; subcaudals 23.

SIZE.— Total length 293 mm. (one ♂); tail length 23 mm.
DISTRIBUTION.— Endemic to Philippines (Luzon [Prov.: Aurora]; Polillo).

Genus *Naja*

Cobras

Naja Laurenti, 1768:90 (Type species: *Naja lutescens* Laurenti, 1768 = *Coluber naja* Linnaeus, 1758 [see Williams and Wallach 1989:97; also David and Ineich 1999:156]).

DIAGNOSIS.— Maxillary bone extends forward beyond palatine; venom fangs moderately short, followed by from 0 to 2 small teeth; eye moderate, pupil round; nostril large, between two nasal scales; loreal scale absent; body scales smooth, in 19–25 longitudinal rows at midbody (for Southeast Asian species only); hemipenes relatively short, forked for less than half their length, variously spinose throughout.

Naja philippinensis Taylor, 1922

Philippine Cobra; Northern Philippine Cobra
Figures 4, 34, 35A–B

Naja naja philippinensis Taylor, 1922a:265 (Type locality: Manila, Luzon Island).— Leviton, 1964:539.
Naja philippinensis, Wüster and Thorpe, 1990:336-341.— Toriba, 1993:191.— David and Ineich, 1999:166.

DESCRIPTION.— Color above light brown to olive brown, below lighter cream to yellowish brown, without any distinctive dark bands or other markings anteriorly; scales in 23–25 longitudinal rows around neck, 21 longitudinal rows at midbody, and 15 just before the vent (scale row reduction: 23[25]–21–15); ventrals 181–191; subcaudals 38–47; precloacal scale single.

SIZE.— Snout-vent length (♂) 1223 mm, (♀) 960 mm; tail length (♂) 189 mm, (♀) 195 mm.

DISTRIBUTION.— Endemic to Philippines (Luzon [Prov.: Aurora, Batangas, Bulacan, Cavite, Laguna, Pampanga, Pangasinan, Quezon, Rizal]; Marinduque; Mindoro).

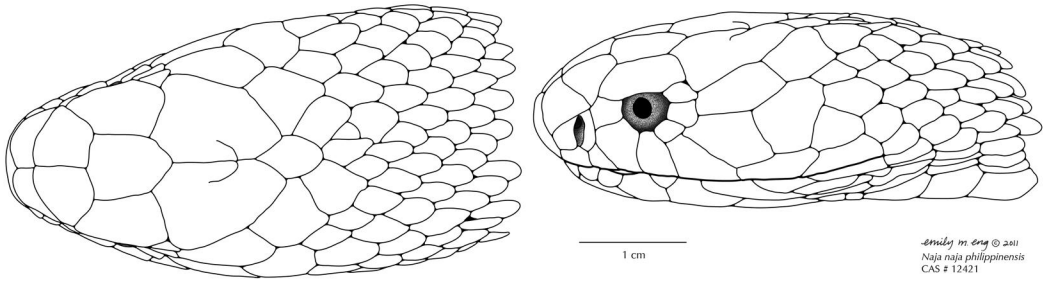


FIGURE 34. *Naja philippinensis* Taylor, 1922. Illustrations by Emily M. Eng.

Naja samarensis Peters, 1861

Central Philippine Cobra
Figure 35C

Naja tripudians samarensis Peters, 1861:690 (Type locality: Samar Island).
Naja samarensis, Boulenger, 1896:385.— Taylor, 1922a:259.— Wüster and Thorpe, 1990:336-341.
Naja naja samarensis, Leviton, 1964:542.

DESCRIPTION.— Color above dark brown to black, usually with a trace of a light lateral line, at least anteriorly, on outer two scale rows; below, throat and first few ventrals yellowish followed by a distinct broad black band, which gradually fades to light gray; scales in 21–23 longitudinal rows around the neck, 19 longitudinal rows at midbody, and 13 longitudinal rows just before the

vent (scale row reduction: 23[21]–19–13); ventrals 162–178; subcaudals 42–50; precloacal scale single.

SIZE.— Snout-vent length (♂) 843 mm, (♀) 921 mm; tail length (♂) 158 mm, (♀) 155 mm.

DISTRIBUTION.— Endemic to Philippines (Bohol; Leyte; Mindanao [Prov.: Agusan, Bukidnon, Lanao, Misamis Occidental, Zamboanga]; Samar).

Naja sumatrana F. Müller, 1887

Equatorial or Sumatran spitting Cobra

Naja tripudians var. sumatrana Müller, 1887:277 (Type locality: Solok, Prov. Sumatera Barat, Sumatra, Indonesia.)

Naja naja miolepis, Taylor, 1922a:262.— Leviton, 1964:538.

Naja sumatrana, Wüster and Thorpe, 1989:336-341.— Toriba, 1993:192.— David and Ineich, 1999:168.

DESCRIPTION.— Color above black or dark brown, below dark or light but without a distinctive black band on anterior postion of bdy; scales in 23 longitudinal rows abound the neck, 17–19 longitudinal rows at midbody; and 13 rows longitudinal rows just before the vent (scale row reduction: 23–[17]19–13); ventrals 178–195; subcaudals 46–51; precloacal scale single.

SIZE.— Snout-vent length (♂) 1227 mm, (♀) 1057 mm; tail length (♂) 177 mm, (♀) 150 mm.

DISTRIBUTION.— Philippines (Culion; Palawan). Elsewhere: Thailand (southern), Malaysia (Peninsula, Borneo), Indonesia.

Genus *Ophiophagus* Günther, 1864

Ophiophagus Günther, 1864:340 (Type species: *Hamadryas elaps* Günther, 1864 [= *Hamadryas hannah* Cantor, 1836]).— Leviton, 1964:544.

DIAGNOSIS.— Maxillary bone extends forward beyond palatine; venom fangs short, followed by three short teeth; head barely distinct from neck; nostril large, between two nasal scales; loreal scale absent; scales smooth, in 15 longitudinal rows at midbody; subcaudal scales partially single, partially divided; hemipenes very elongate, forked for most of their length; hypapophyses present on posterior vertebrate.

Ophiophagus hannah (Cantor, 1836)

King Cobra

Figures 7A–B, 36, 37

Ophiophagus hannah, Günther, 1864:341.— Leviton, 1964:544.— Alcala, 1986a:161; 1986b:161.— Toriba, 1993:195.— David and Ineich, 1999:171.

Naja hannah, Taylor, 1922:256, pl. 31.— Smith, 1943:436.

DESCRIPTION.— Color variable, dorsum uniform olive to dark brown in adults, scales often with black borders, juveniles dark brown to black with yellow rings; ventral surface, chin and throat cream white, becomming darker posteriorly. Maxillary bone extends forward beyond palatine; venom fangs short, followed by three small teeth; pterygoid teeth 10–12; head barely distinct from neck; eye moderate, pupil round; nasal large, nostril between two nasals; loreal absent; scales smooth, in 15 longitudinal rows throughout; caudodorsal scales reduce: 6 (2+3 [43–46]) 6; subcaudals 90–116.

SIZE.— Snout-vent length (♂) 1610 mm, (♀) 1590 mm; tail length (♂) 430 mm, (♀) 395 mm

DISTRIBUTION.— Philippines (Balabac; Jolo; Luzon [Prov. Aurora, Benguet, Bulacan, Isabela, Laguna]; Mindanao (southern); Mindoro; Negros [Prov.: Negros Oriental]; Palawan; Polillo). Elsewhere: Pakistan through South and Southeast Asia, southern China, Malaysia, Singapore, Indonesia.

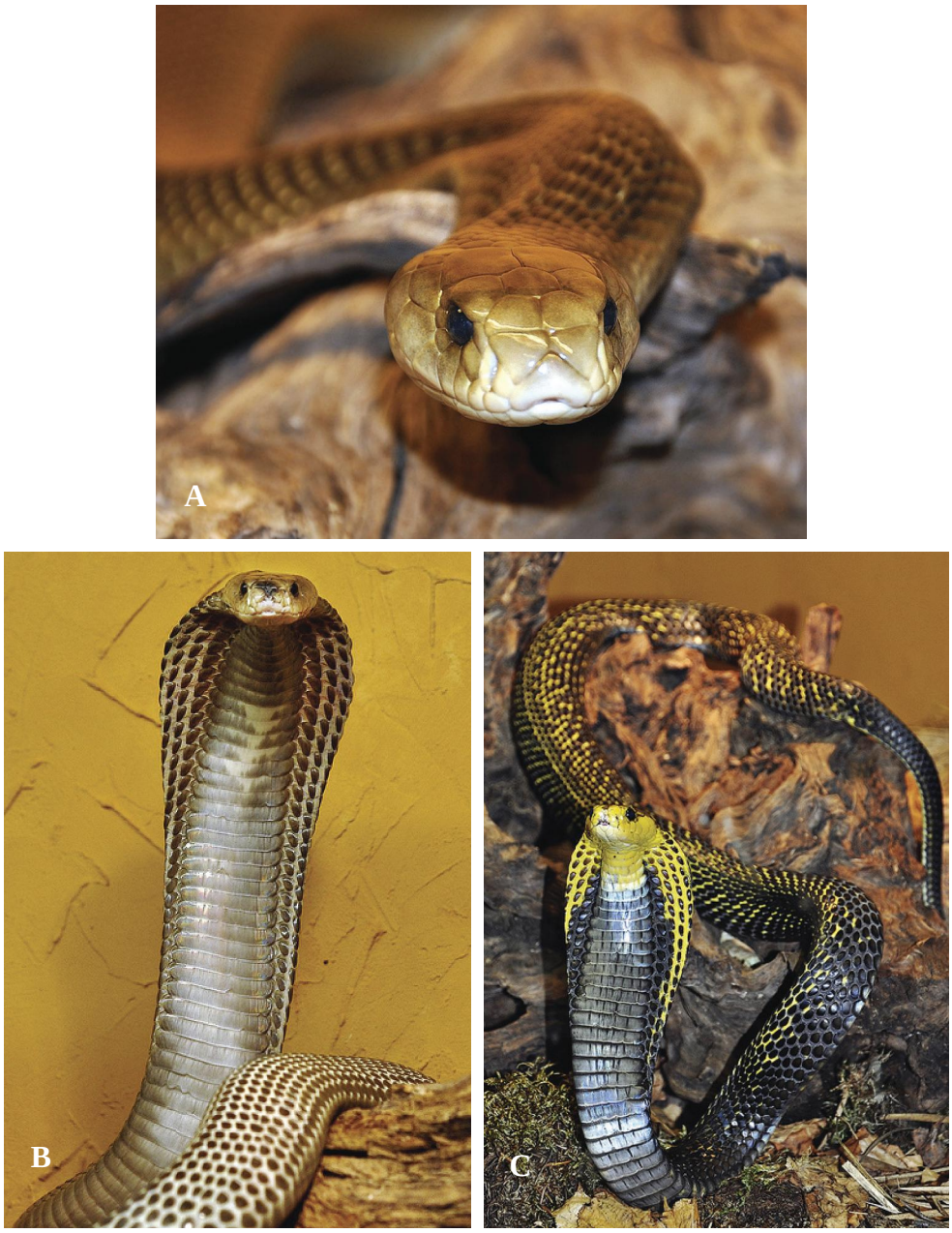


FIGURE 35A–C. A. *Naja philippinensis.* B. *Naja philippinensis.* C. *Naja samarensis.* Photos courtesy of Markus Oulehla.

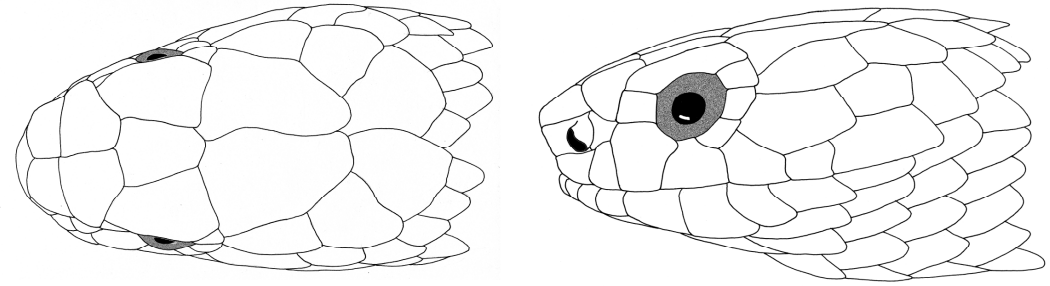


FIGURE 36. *Ophiophagus hannah* (Cantor, 1836). Illustrations by Marilyn Kramer.

FIGURE 37. *Ophiophagus hannah*. Photo by Hla Tun.

Subfamily Hydrophiinae

REMARKS.— Sea snakes are, taxonomically, among the most poorly understood group of reptiles. In recent years, at least dating from McDowell's efforts in 1972 to redefine the major groups of hydrophine sea snakes, to 2013, with Sanders et al. multilocus phylogeny of viviparous sea snakes, rarely do two authors agree on the phylogenetic relations among the snakes let alone the reality of species that exist. However, significant strides have been made mostly through the efforts of Sanders et al. (2013), Rasmussen (e.g., 1989, 1997, 2010), Rasmussen et al. (2011), Heatwole, et al. (2005), Lukoschek and Keogh (2006), Voris (1977), and Voris and Voris (1983), and with the further application of molecular RNA/DNA studies, a clearer picture of sea snake diversity and relationships should emerge in the forseeable future. In the meantime, we have chosen to follow the recommendations of Sanders and co-authors to wit, "Division [of the sea snakes] into multiple poorly defined genera would . . . fail to represent the history of recent rapid diversification of these taxa . . . For these reasons, we recommend recognizing a single genus, *Hydrophis* Latreille 1802, for the core *Hydrophis* group [which includes *Acalyptophis, Astrotia, Kerilia, Lapemis, Pelamis, Thalassophina*]. The taxon *Hydrophis* is well known as comprising dangerously venomous sea snakes; hence, retaining this name (instead of adding multiple new genera) will create less confusion for conservationists, medical professionals, and fishing industries/communities as well as herpetologists." (Sanders et al. 2013:584.)

Most sea snakes are obligate aquatic animals that rarely, if ever come onto land except when swept ashore by wind and waves. However, at least three species, often referred to a distinct subfamily, the Laticaudinae, *Laticauda colubrina, L. laticaudata,* and *L. semifasciata,* regularly come onto land to rest and lay eggs, but otherwise they feed in water. Also, "three of the most 'primitive' true sea snakes (Subfamily Hydrophiinae) (*Ephalophis greyi*, *Hydrelaps darwiniensis*, and *Parahydrophis mertoni*)" (Rasmussen 1992:57), none of which occur in Philippine waters, have been observed emerging to forage on land for small burrowing gobies and then taking refuge in small burrows until the next tide allows them to return to the water (Rasmussen 1992:57 and for references).

Description data accompanying each of the sea snake species have been culled largedly from details given in Smith (1926) and adjusted where necessary based on newer materials.

Genus *Aipysurus* Lacepède, 1804

Aipysurus Lacepède, 1804:197.— Smith, 1926:13.

DIAGNOSIS.— Maxillary bone extends forward beyond palatine, as long as or longer than ectoptergyoid; 5–11 maxillary teeth behind front fangs; nostrils superior, nasal scales in contact with one another; head scales variable, either whole or broken into smaller scales; body scales imbricate, in 17–15 rows around body; ventrals large, ⅓ to ½ width of body, scales usually with medial keel, best developed posteriorly. (Modified after Smith 1926:13.)

REMARKS.— See comments about *Aipysurus* in Rasmussen (2002:56).

Aipysurus eydouxii (Gray, 1849)

Spine-tailed or Marbled Sea Snake

Tomogaster eydouxii Gray, 1849:59.
Aipysurus eydouxii, Smith, 1926:14.

DESCRIPTION.— Body nearly of uniform diameter throughout, cylindrical; 10–11 maxillary teeth behind fangs; body scales, imbricate, smooth, in 17 rows on neck and body, 15 rows just before vent; dorsal scales on head large, regular, frontal longer than its distance from tip of snout; prefrontals usually two but occasionally divided by transverse groves to four; one pre- and two postoculars; six upper labials, fourth bordering orbit of eye; six lower labials; ventrals (♂) 129–137, (♀) 135–146, each with a more or less developed median keel that in adult males ends in a strong spinous tubercle; subcaudals (♂) 30–32, (♀) 23–27; brownish or olive above with 44–55 yellow, black-edged scales forming crossbands, usually broken along mid-dorsal line.

SIZE.— Total length usually to 550 mm (but Smith [1926:15] records one ♀ from Java at 910 mm).

DISTRIBUTION.— Philippines (although reported for the Philippines, no verifiable records or voucher specimens ["I have seen no specimens. Both Boulenger {1896:304} and Wall {1910:189} give the Philippines as part of its range, and the species is included in the present work on their authority." {Taylor, 1922a:227}]; Smith [1926:16] also questions the authenticity of Boulenger's report.). Elsewhere: widely distributed in coastal waters off of Australia (Queensland, Northern Territory, Western Australia), New Guinea, Indonesia, Gulf of Thailand, Singapore, Malaysia, South China Sea.

Genus *Emydocephalus* Krefft, 1869

Emydocephalus Krefft, 1869:321.— Smith, 1926:26.

DIAGNOSIS.— Maxillary bone shorter than ectopterygoid and extends forward beyond palatine; no maxillary teeth present following the very small venom fangs; nostrils superior; nasal scales in contact with one another dorsally; scales in dorsum of head large; second upper labial scale very elongate; scales on body imbricate, in 15–19 longitudinal rows at midbody.

Emydocephalus annulatus Krefft, 1869

Annulated Sea Snake

Emydocephalus annulatus Krefft, 1869:322.— Smith, 1926:26.— Alcala, 1986a:162.— David and Ineich, 1999:91.

DESCRIPTION.— Body of nearly uniform diameter throughout; head short, above covered with large, regular scales; rostral five-sided, usually with a projecting spine; prefrontals not in contact with upper labials; one preocular, two postocular scales; temporals small, 2 anterior, three posterior; upper labials 3, second very elongate; 4 lower labials; body scales in 15 longitudinal rows on neck, 15–17 around midbody, strongly imbricate; ventrals distinct, 125–145, with small tubercles and usually with a median keel; subcaudals 20–40, undivided; precloacal (anal) scale single; body color variable, uniform dark grey, brown to black above or yellowish white with 23–35 variegated brown or black rings; head variable, creamy white, yellowish, or dark brown or black, with dark or light markings.

SIZE.— Total length 910 mm; tail length 110 mm.

DISTRIBUTION.— Philippines: according to Alcala (1986:163), "Probably all over Philippine seas" but without exact references. Elsewhere: Australia, Papua New Guinea, Indonesia (Irian), Loyalty Islands.

Genus *Hydrophis* Latreille in Sonnini and Latreille, 1801

Hydrophis Latrielle, 1802:193.— Smith, 1926:40; 1943:451.— McCarthy, 1993:229.
Pelamis Daudin, 1803:361. *Disteira* Lacepède, 1804:210.
Leioselasma Lacépède, 1804:210.
Lapemis Gray in Hardwicke and Gray, 1835, vol. 2, pl. 87, fig. 2.— Smith, 1926:108.— McCarthy, 1993:243.— Rasmussen, 1996:22.— David and Ineich, 1999:121.
Aturia Gray, 1842:61.
Enhydrina Gray, 1849:47.
Kerilia Gray, 1849:57.— Smith, 1926:31.— David and Ineich, 1999:120.
Thalassophis Schmidt, 1852:75.— Smith, 1926:103.— David and Ineich, 1999:197.
Astrotia Fischer, 1856:38.— Smith. 1926:113.— David and Ineich, 1999:63.
Acalyptophis Boulenger, 1896:269.— Smith, 1926:101.
Praescutata Wall, 1921:390.— David and Ineich, 1999:176.
Thalassophina Smith, 1926:33.— Rasmussen, 1997:23.
Kolpophis Smith, 1926:106.— Rasmussen, 1996:23.— David and Ineich, 1999:120.

DIAGNOSIS.— Maxillary bone does not extend forward beyond palatine; 1–18 maxillary teeth behind venom fangs and separated by a small interval (diastema); nostrils superior; nasal scales in contact with one another or separated by elongate scales; dorsal head scales regular, large; body scales imbricate to juxtaposed; ventrals small, usually distinct and undivided.

REMARKS.— David and Ineich (1999:104) reviewed the controversy surrounding the use of the name *Hydrophis* to include several nominal taxa, *Disteira*, *Leioselasma*, and *Aturia* that had

been recognized by various authors. In so doing, they followed Rasmussen (1996), who also recommended recognizing *Astrotia* and *Enhydrina* as distinct genera. More recently, several phylogenetic studies have led to the abandoment of at least 10 heretofore recognized genera by placing them and their included species in the genus *Hydrophis* (Sanders et al. 2013; Pyron et al. 2013). Although we have adopted the newly proposed taxonomic arrangements here, we have also indicated where those changes have occurred by including in brackets [ ] the genus name to which the respective species had been previously assigned. It should be noted that the bracketed name does not imply a subgenus designation..

In the descriptions that follow, body lengths, that is total lengths and tail lengths, are for the largest specimens we have found recorded, mostly as recorded by Smith (1926) but adjusted if more recent information were available.

Hydrophis [*Kolpophis*] *annandalei* (Laidlaw, 1901)

Annandale's Sea Snake

Distira annandalei Laidlaw, 1901:579, pl. 35.
Kolpophis annandalei, Smith, 1926:106.— David and Ineich, 1999:121.

DESCRIPTION.— Body short, stout, greatest body diameter not quite twice that of neck; head large, with nasal and prefrontal scales usually divided; supraocular, frontal, and parietals entire, the latter usually separated by small scales; 9–11 upper labials, often fragmented; temporals small, irregular; lower labials, small or indistinct and separated from labial margin by small scales; scale rows: around neck 62–82, around midbody 74–93, hexagonal, juxtaposed or subimbricate, smooth or with short keel; ventrals distinct throughout, 320–368; precloacal scales enlarged. (After Smith 1926:106.)

SIZE.— Total length (♂) 910 mm; tail length (♂) 120 mm.

DISTRIBUTION.— Philippines (not yet reported from the Philippines but has been reported from coastal waters of northern Borneo [Brunei] and Vietnam in the South China Sea as well as the Gulf of Thailand). Elsewhere: Indonesia (Java), Singapore, Malaysia, and Thailand (see David and Ineich 1999:121 for references).

Hydrophis [*Thalassophis*] *anomalus* Schmidt, 1852

Anomalous Sea Snake

Thalassophis anomalus Schmidt, 1852:81.— Smith, 1926:104.— David and Ineich, 1999:197.— Stuebing and Inger, 1999:221.

DESCRIPTION.— Head short; above, rostral fragmented into 4–5 small scales; nasals separated by elongate scales; frontal small, sometimes divided; one pre- and two postoculars; temporals 2 or 3 anterior, three posterior scales, small, scarcely larger than adjacent scales; 6–7 upper labials, second usually in contact with prefrontal, 3–5 bordering orbit of eye; 4 lower labials in contact with sublabials; 27–30 scale rows around neck, 31–35 at midbody, posterior scales hexagonal in shape, juxtaposed and keeled; ventrals scarcely broader than adjacent scales, 210–256, bicarinate; precloacal scales slightly enlarged.

SIZE.— Total length (♂) 810 mm, (♀) 755; tail length (♂) 90 mm, (♀) 85 mm.

DISTRIBUTION.— Philippines (not yet reported from coastal Philippine waters but one record for the northern coast of Borneo [Brunei] and elsewhere in the Gulf of Thailand). Elsewhere: Indonesia (Java, Kalimantan, Moluccas), Malaysia, Singapore, Thailand, Vietnam.

Hydrophis atriceps Günther, 1864

Southeast Asian Sea Snake

Figure 19B, 23A, 24A

Hydrophis atriceps Günther, 1864:371, fig.— McCarthy, 1993:230.— David and Ineich, 1999:104.— Rasmussen 2001:4001, 1 fig.

Hydrophis fasciatus atriceps, Smith, 1926:97, fig. 27; 1943:465.

DIAGNOSIS.— Head small, body long and slender anteriorly; scales on thickest part of body subquadrangular or hexagonal in shape, juxtaposed or slightly imbricate; 5–6 maxillary teeth behind fangs; 2 anterior temporals; body scales in 25–30 (usually 27–29) rows around the neck, 39–49 (usually 43–53) around midbody (increase in number of rows from neck to midbody 12–20); ventral scales 320–455 (average 366 or less); anterior part of body including head and neck dark olive to black with pale oval yellowish spots on sides, sometimes connected as crossbars; posterior, grayish; below whitish; dark rhomboidal spots may extend down the sides of the body and form complete annuli in young.

SIZE.— Total length (♂) 1100 mm, (♀) 990 mm; tail length (♂) 100 mm, (♀) 75 mm.

DISTRIBUTION.— Philippines (Mindanao; Samar; Sulu Archipelago; Visayan Sea). Elsewhere: coastal waters off the east coast of Malaysia, Gulf of Thailand,Vietnam, southern China, Indonesia to western New Guinea, and northern Australia.

REMARKS.— This species is so similar in appearance to *H. fasciatus* that the two have been regarded as conspecific, though treated as distinct subspecies (Smith 1926, 1943), but recent studies have treated tham as distinct species (see McCarthy 1993:230, 234; David and Ineich 1999:104, 109). Alcala (1986:164) referred to records from the Visayan Sea and areas around Samar, Mindanao, and the Sulu islands to *H. fasciatus* but David and Ineich (1999:105) noted that "According to A. R. Rasmussen (pers. commun., June 1996), all references of *Hydrophis fasciatus* based on specimens taken East of Malacca Strait, from Gulf of Thailand to southern China and to the north coast of Australia, belong to *Hydrophis atriceps*; we follow his interpretation." We accept this interpretation as well.

Hydrophis belcheri (Gray, 1849)

Belcher's Sea Snake

Aturia belcheri Gray, 1849:46.

Hydrophis belcheri, McCarthy, 1993:230.— David and Ineich, 1999:105.— Rasmussen et al., 2011:5.

DESCRIPTION.— Head moderate, body elongate, compressed posteriorly, two to four times the diameter of the neck; 7–8 [rarely 6 or 9] maxillary teeth behind venom fangs; normally one supralabial (4th, but occasionally two, 3rd and 4th or 4th and 5th) borders eye; one anterior temporal, occasionally divided by a horizontal groove; 24–27 scales around neck, 32–37 around midbody; ventrals 278–313; body color yellow or grayish above, yellow-whitish below, 52–70 dark bands, head black in young, lighter in adults, with yellowish or olive markings. (After Rasmussen et al. 2011:5.)

SIZE.— Total length (♂) 1240 mm, (♀) 1110 mm; tail length (♂) 120 mm, (♀) 90 mm.

DISTRIBUTION.— Philippines (unknown although Alcala (1986a:166) states that it "has been recorded from the central Philippine sea."; otherwise, it has been reported from the coastal waters off of Vietnam in the South China Sea [Rasmussen et al. 2011:5]). Elsewhere: Gulf of Thailand, Vietnam, Indonesia, and New Guinea (David and Ineich [1999:105] noting earlier discussions by McDowell [1972:217] and McCarthy and Warrell [1991:162–163], now refer the Australasian records to *Hydrophis pacificus*, but see also Kharin [2005:161], whose observations heighten the confusion regarding the identification of samples of populations supposedly belonging to *H. belcheri.* See also comments by Rasmussen (2001) relating to *H. coggeri.*

Hydrophis brookii Günther, 1872

Brook's Sea Snake

Hydrophis brookii Günther, 1872:597, fig. (Type locality: Sarawak [coast], Borneo, Malaysia).— Smith, 1926: 99.— David and Ineich, 1999:106.— Stuebing and Inger, 1999:207.— Rasmussen et al., 2011:5.

DESCRIPTION.— Head very small, body very slender anteriorly, compressed posteriory and two to three times diameter of neck; 4–5 maxillary teeth behind venom fangs; scales at midbody subimbricate, hexagonal in shape, often with a median tubercle or keel; 6, occasionally only 5, upper labials, 3rd and 4th border eye; scales in 23–31 rows around neck, 37–45 around midbody; ventrals 328–414, distinct throughout; color (live) bluish white (greyish in preserved specimens), with 60–80 dark grey (black) bands, anteriorly they encircle body and are about twice as broad as the interspaces, posteriorly they narrow on the sides and may be incomplete below; head black or dark grey with curved yellow horseshoe-shaped marking across snout and extending back along sides of head. (Modified from Smith 1926:100–101 and Rasmussen et al. 2011:5.)

SIZE.— Total length (♂) 1040 mm, (♀) 965 mm; tail length (♂) 115 mm, (♀) 75 mm.

DISTRIBUTION.— Philippines (unknown, but it has been reported from South China Sea, along the coast of Sarawak, Borneo [Smith 1926:101; Stuebing and Inger 1999:207] and Vietnam [David and Ineich 1999:106; Rasmussen 2011:5]). Elsewhere: Thailand, Indonesia, Malaysia, Singapore, Vietnam, Sarawak coast of Borneo.

Hydrophis coggeri (Kharin, 1984)

Cogger's Sea Snake; Pacific Yellow-banded Seasnake

Leioselasma coggeri Kharin 1984a:1538, fig. b.— David and Ineich 1999:107.— Rasmussen 2001:4002, figs.

DESCRIPTION.— Head and body variable, "small head and slender neck, others with more robust body" (Rasmussen, *op. cit.*); 5–8 maxillary teeth behind venom fangs; scales in 22–39 rows around neck, 29–35 around midbody; ventrals, 278–325; head uniformly dark brown to black, body olive with encircling dark bands on body and tail.

SIZE.— Total length 1150 mm.

DISTRIBUTION.— Philippines (said to occur in the Philippines [Rasmussen 2001:4002 and distribution map; also Zug 2013:229] but most likely *H. melanocephalus* [see Rasmussen et al. 2011:6]). Elsewhere: north coast of Australia, New Caledonia, east to Vanuatu and Fiji.

Hydrophis [*Lapemis*] *curtus* Shaw, 1802

Short or Hardwicke's Sea Snake

Figures 27D, 28–29, 37–38

Lapemis curtus Shaw, 1802:562.— Zhao and Adler, 1993:269.— Gritis and Voris, 1990: 1–11.— Whitaker and Captain, 2004:398, photo (p. 399). McCarthy, 1993:244.— David and Ineich, 1999:121.

Lapemis hardwickii Gray in Hardwicke and Gray, 1835, vol. 2, pl. 87.— Smith, 1926:108, fig. 32, pl. 1, fig. 3; 1943:468, figs. 148–149.

Lapemis curtus hardwickii, McCarthy, 1993:244.

DESCRIPTION.— Body short, stout, diameter of neck region at least half that of the midbody; head large, scales on dorsum of head regular (Fig. 37), entire, parietals occasionally divided, nostrils superior, nasals in contact with one another; prefrontal usually in contact with second upper labial, 7–8 upper labials, 3–4 bordering eye, 1 pre- and 1–2 postoculars, 2, rarely 3, anterior temporals; body scales squarish or hexagonal, juxtaposed, outer 3–4 rows larger than others, scale rows: around neck (♂) 23–31, (♀) 27–35, around midbody, (♂) 25–27, (♀) 33– 41; ventrals small, usually distinct anteriorly, not so posteriorly, (♂) 114–186, (♀) 141–230; greenish or yellow-olive above, whitish below, 35–50 olive to dark gray dorsal bars, tapering to a point laterally, occasion-

FIGURE 37. *Hydrophis* [*Lapemis*] *curtus* Shaw, 1802. Photo courtesy of Harold Voris.

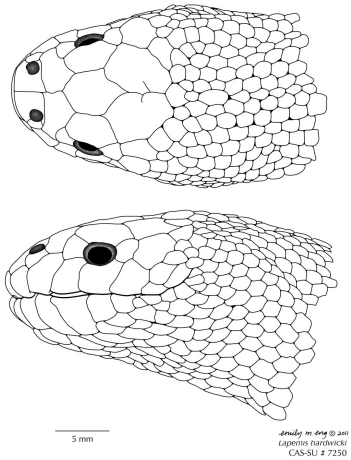


FIGURE 38. *Hydrophis* [*Lapemis*] *curtus* Shaw, 1802. Drawing by Emily M. Eng.

ally encircling body, a narrow dark ventral stripe or broad irregular band occasionally present; adults often lack any pattern and are uniform olive to dark gray; head pale olive to black, yellow markings on snout present or not.

SIZE.— Total length 850 mm (1100 mm, *fide* Rasmussen et al. 2011); tail length 85 mm.

DISTRIBUTION.— Philippines (reported from the Visayan Sea [*fide* Alcala 1986:170]). Elsewhere: southeast coast of India to Straits of Malacca, Indonesia, and Australia, and north to China, Taiwan, and Japan.

REMARKS.— Gritis and Voris (1990) do not recognize *Lapemis hardwickii* [now *Hydrophis hardwicki*] as a distinct species, placing it in the synonymy of *L. curtus*. McCarthy (1993) recognized it as a subspecies of *L. curtus*, allowing that the nominate form inhabits coastal waters from the Persian Gulf to the shores of western India, and *L. curtus hardwickii* ranges from the coastal waters of Sri Lanka and eastern India to New Guinea and Australia and north to the coast of China, the Philippines, and Japan (see also David and Ineich 1999:121–122). Smith (1926:113, 1943:471) argued that *L. curtus* ranges from the Persian Gulf to the west coast of India as far as Sri Lanka but that it is unknown along the east coast of India. We follow Gritis and Voris in this handbook inasmuch as theirs is the most comprehensive analysis of character variation done so far, and based on their study there are no mophological features that justify recognizing two species although we emphasize that recent phylogenetic studies (Sanders et al. 2013) place the genus *Lapemis* and its included species in the genus *Hydrophis*.

***Hydrophis cyanocinctus* Daudin, 1803**

Annulated Sea Snake; Many-banded Sea Snake
Figures 19B, 20B, 23B, 25B, 26A–B, 39

Hydrophis cyanocinctus Daudin, 1803:383.— Smith, 1926:56; 1943:454.— Whitaker and Captain, 2004:392, photo (p. 303).

DESCRIPTION.— Head moderate, body elongate, not slender anteriorly; scales on thickest part of body overlapping (imbricate) throughout, with medial keel or broken into two or three tubercles; 5–8 maxillary teeth behind venom fangs; ordinarily two anterior temporals; scales in 27–35 rows on the neck, 37–47 around midbody (increase from neck to midbody 8–14); ventrals 290–390, distinct throughout, about twice as broad as adjacent scales; head in adult olive or yellowish, in young, head black or dark olive; young with black annuli that broaden dorsally and occasionally a black

ventral stripe; in adults, ventral stripe and lower portions of annuli less distinct but dorsal portion of annuli remain distinct.

SIZE.— Total length (♂) 1500 mm, (♀) 1885 mm; tail length (♂) 130 mm, (♀) 135 mm.

DISTRIBUTION.— Philippines (Luzon; Visayan region) (*fide* Alcala 1986a:164). Elsewhere: Extensive range from Persian/Arabian Gulf east to Indonesia and north to the Idzu Sea, Japan (see David and Ineich [1999:108] for details).

FIGURE 39. *Hydrophis cyanocinctus* Daudin, 1803 (inset: close-up view of head). Photos courtesy of Harold Voris

Hydrophis gracilis (Shaw, 1802)

Common Small-headed Sea Snake

Figure 19C

"Kadell nagam" Russel, 1801:pl. 15, pl. 13.

Hydrus gracilis Shaw, 1802:560 (Type locality: unknown).

Microcephalophis gracilis, Smith, 1926:121. — David and Ineich, 1999:110.— Rasmussen et al. 2011:6.

DESCRIPTION.— Head very small, elongate, snout projecting beyond lower jaw; body long and slender anteriorly, compressed posteriorly and four to five times the diameter of neck; 5–6 maxillary teeth behind front poison fangs; rostral scale large, extending well onto upper surface of snout; scale rows on neck 17–23, on body 30–43, posterior scales hexagonal, juxtaposed, broader than long, with two or three tubercles, one behind the other; ventrals 215–350, entire and broader than adjacent body scales on anterior slender portion of body, completely divided posteriorly by a median groove, the two halves apposed or alternating to one another; precloacal scales slightly enlarged; color in young black anteriorly with whitish dorsal bands or oval spots laterally, 40–60 more or less complete bands posteriorly, in adults markings lose definition and body becomes more uniformly greyish above, and paler below.

SIZE.— Total length (♂) 950 mm, (♀) 1025mm; tail length (♂) 80 mm, (♀) 95 mm.

DISTRIBUTION.— Philippines (this species has not been recorded from the Philippines but it has been found in the South China Sea off the coast of Vietnam and southern China). Elsewhere: widely distributed from Persian/Arabian Gulf (coastal Saudi Arabia, Kuwait, Iraq, Iran, and Oman) east to the Bay of Bengal, Gulf of Thailand, Malaya and Singapore, South China Sea, and Indonesia, to New Guinea (Gulf of Guinea).

REMARKS.— Smith (1943:473) provides information on the geographic variation in scale counts for this species.

Hydrophis inornatus (Gray, 1849)

REMARKS.— According to David and Ineich (1999:111), Rasmussen (1989) referred records of Philippine and Indonesian *H. inornatus* to *H. ornatus* (see Rasmussen synonymy, 1989:399, also comments on p. 410). Rasmussen also states, "However, the acceptance of *H. inornatus* as a separate species is explicitly preliminary and further study may show that the type specimen of *H. inornatus* is an abberant specimen of *H. ornatus*." (Rasmussen 1989:415.)

Hydrophis [*Kerilia*] *jerdoni* Gray, 1849

Jerdon's Sea Snake

Kerilia jerdoni Gray, 1849:57.— Smith, 1926:31.— David and Ineich, 1999:120.— Stuebing and Inger, 1999:214.— Rasmussen et al., 2011:8.

DESCRIPTION.— Head short, narrowed anteriorly; body robost, elongate; 7–9 maxillary teeth behind fangs; scales on body longer than broad, imbricate throughout, strongly keeled, in 15–17 rows around neck, 19–23 at mid-body; ventrals 200–273, distinct throughout but only slightly broader than adjacent scales; body yellow above, yellowish or whitish below, with black bands that are wider above and usually fade laterally.

SIZE.— Total length 940 mm; tail length 100 mm.

DISTRIBUTION.— Philippines (not yet reported from the Philippines but has been reported from coastal waters of northern Borneo and coastal waters elsewhere in the South China north to Taiwan). Elsewhere: widely distributed from coastal waters of southeast Indian Peninsula, Sri Lanka, Myanmar, Thailand, Mergui Archipelago, Malacca Straits, Singapore, and west and northwest coast of Borneo.

REMARKS.— Two subspecies of *Kerilia jerdoni* have been recognized, but not all authors agree on their status. *Kerilia j. jerdoni* is the form that would be encountered along in the Bay of Bengal along the coasts of southeast India, Sri Lanka, and Myanmar, whereas *K. j. siamensis* ranges from the east coast of Peninsular Thailand to the Borneo coast (Rasmussen and Anderson 1990).

Although not yet recorded from the Philippines, its occurrence in shallow coastal waters off the coast of northern Borneo suggests it will likely be found in coastal waters off of the Palawan Island group and perhaps in the Sulu Sea.

Hydrophis klossi Boulenger, 1912

Kloss's Sea Snake

Hydrophis klossi Boulenger, 1912:190.— Smith, 1926:68.— Stuebing and Inger, 1999:210.— David and Ineich, 1999:112.

DESCRIPTION.— Head small, body anteriorly slender, posteriorly two to three times diameter of neck, compressed; 5–6 maxillary teeth behind venom fangs; scale rows on neck 23–25 (27), at midbody 31–37 (39); ventrals distinct throughout, 360–413, less than twice as broad as adjacent body scalers; precloacal scales enlarged; Head dark olive to dark brown, sometimes with elongate whitish spots or indistinct horseshoe shaped marking; body above grey with 50–75 dark bands that encircle body, broadest above and broader than interspaces; below, underside of head dark and anterior portion of body dark, posteriorly sides of body and belly yellowish-white, posteriorly, greyish; tip of tail black. (After Smith 1926:68 and Stuebing and Inger 1999:210.)

SIZE.— Total length (♂) 1090 mm, (♀) 1300; tail length (♂) 115 mm, (♀) 110 mm.

DISTRIBUTION.— Philippines (not yet reported from Philippine waters; Stuebing and Inger [1999:210] report one specimen off the coast of northern Borneo). Elsewhere: east coast of Malay Peninsula, Thailand, Singapore, western Indonesia (Sumatra).

Hydrophis lamberti Smith, 1917

Lambert's Sea Snake

Hydrophis lamberti Smith, 1917:340.
Hydrophis ornatus, (part) Smith, 1926:81.— Dunson and Minton, 1978:281.— Minton, 1978:151.
Hydrophis lamberti, Rasmussen, 1989:410.— Rasmussen et al., 2011:6.

DESCRIPTION.— Head large, robust; 9–12 maxillary teeth behind front fangs; scale rows on neck (♂) 38–42, (♀) 37–45, on body (♂) 45–52, (♀) 49–56; ventrals distinct throughout, anteriorly about twice as broad as adjacent scales, (♂) 258–395, (♀) 237–306; subcaudals, (♂) 37–50, (♀) 34–44; color, head greyish or brown above, whitish below; body with large oval-shaped bands anteriorly, replaced by cross-bands with broad interspaces posteriorly, dark bands both widest and darkest dorsally, lighter and narrower laterally; on tail,greyish black bands and broad whitish interspaces, 4–6 in (♂), 5–6 in (♀). (After Rasmussen 1989:411.)

SIZE.— Total length (♂) 410–1220 mm, (♀) 440–1040 mm.

DISTRIBUTION.— Philippines (Iloilo Prov. [Gigante Ids.]; Luzon [Manila Bay]). Elsewhere: Singapore, Gulf of Thailand, Vietnam.

Hydrophis melanocephalus Gray, 1849

Black-headed Sea Snake

Hydrophis sublaevis var. *melanocephalus* Gray, 1849:53.
Hydrophis melanocephalus, Smith, 1926:64.— McCarthy, 1993:237.— David and Ineich, 1999:114.

DESCRIPTION.— Head small, body elongate and slender anteriorly, compressed posteriorly, the diameter two to three times greater than the neck; 6–8 maxillary teeth behind venom fangs; 23–27 scale rows around neck, 33–41 around midbody (rows increase from 8–14, neck to midbody); ventrals 289–358, distinct throughout, bicarinate, almost twice as broad as adjacent body scales; precloacal scales enlarged; color, head black with yellow spot behind nostrils and a yellow streak behind eye, body olivaceous or greyish, yellowish or white below, with 40–55 black bands about as broad as the interspaces, usually expanding both dorsally and ventrally.

SIZE.— Total length (♂) 1130 mm, (♀) 1230 mm; tail length (♂) 95 mm, (♀) 90 mm.

DISTRIBUTION.— Philippines (*fide* Rasmussen 2011; David and Ineich 1999) but without locality details. Elsewhere: Vietnam, China, Taiwan, Japan (Ryukyu Ids.).

Hydrophis ornatus (Gray, 1842)

Ornate Sea Snake; Reef Sea Snake
Figures 24B, 40–41

Aturia ornata Gray, 1842b:61.
Hydrophis ornatus, Smith, 1926:6.— David and Ineich, 1999:116.— Whitaker and Captain, 2004:394, photo (p. 395).
Hydrophis ornatus ornatus, Smith, 1943:460.— McCarthy, 1993: 239.

DESCRIPTION.— Scales on thickest part of body more or less hexagonal in shape, feebly imbricate or juxtaposed; 9–13 maxillary teeth behind fangs; head large; body robust, not elongate, greatest diameter posteriorly about twice that of the neck; one preocular; two postoculars; two anterior temporals; 7–8 upper labials; scale rows on neck: (♂) 28–40, (♀) 31–45, on thickest part of body, (♂) 33–52, (♀) 39–55 (increase from neck to midbody 4–12); ventrals distinct throughout, in (♂) 209–273, in (♀) 236–312, anteriorly ventrals about twice as large as adjacent scales, narrowing posteriorly; above grayish or light olive to almost white with broad dark bars or rhomboidal spots separated by narrow interspaces; below yellowish or whitish.

SIZE.— Total length (♂) 950 mm, (♀) 860; tail length (♂) 115 mm, (♀) 80 mm.

DISTRIBUTION.— Philippines (Luzon; South Gigante Id.). Elsewhere: Persian [Arabian] Gulf to New Guinea and Australia and north along the coast of China to the Ryukyu Ids. (See also comments by Zug 2013:230 relating to reports of occurrence in the Gilbert Islands.)

REMARKS.— See comments under *H. inornatus*.

FIGURE 40. *Hydrophis ornatus* (Gray, 1842). Photo courtesy of Aaron Lobo

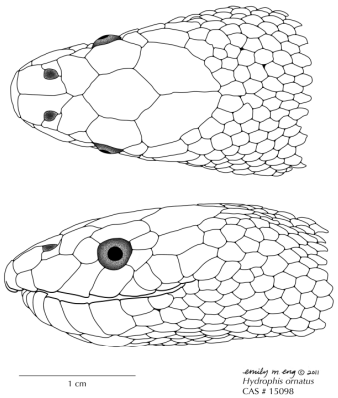


FIGURE 41. *Hydrophis ornatus* (Gray, 1842). Illustrations by Emily M. Eng

Hydrophis [*Acalyptophis*] *peronii* (A.H.A. Duméril, 1853)

Spiny-headed Sea Snake or Horned Sea Snake
Figures 20C, 42

Acalyptus peronii A.H.A. Duméril, 1853:522.
Acalyptophis peronii, Boulenger, 1896:269.— Smith, 1926:102.— McCarthy, 1993:221.— David and Ineich, 1999:55.

DESCRIPTION.— Head short, small, diameter of neck one-third to two-thirds that of the greatest diameter of body; rostril distinctly broader than deep; supraocular with raised, pointed posterior border; 19–23 scale rows on neck, 23–29 around body, with short keels, stronger and spinose in males; ventrals 142–206, as broad as or slightly narrower than adjacent body scales; greyish or pale brown above, whitish below, with or without dark dorsal bars tapering to points on sides; narrow ventral bands or spots may be present.

SIZE.— Total length 1230 mm; tail length 160 mm.

DISTRIBUTION.— Philippines (unknown, but it has been reported from coastal Malaysia and Vietnam in the South China Sea). Elsewhere: Gulf of Siam, including coastal Thailand, Vietnam, Malaysia, Indonesia, South China Sea north to Taiwan, and east to New Guinea, New Caledonia, and Australia.

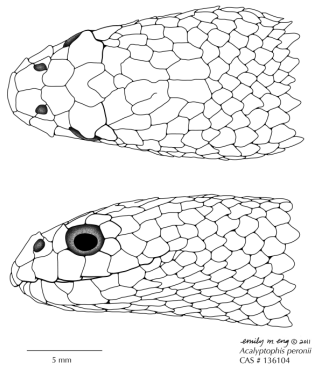


FIGURE 42. *Hydrophis* [*Acalyptophis*] *peronii* (A.H.A. Duméril, 1853). Illustrations by Emily M. Eng.

Hydrophis [*Pelamis*] *platurus* (Linnaeus, 1758)

Pelagic Sea Snake; Yellow-bellied Sea Snake
Figures 27A, 27C, 30, 43–44

Anguis platura Linnaeus, 1766:391.
Pelamis platurus, Smith, 1926:116, fig. 33; 1943:476.— McCarthy, 1993:245.— David and Ineich, 1999:174.— Whitaker and Captain, 2004:402, photo (p. 403).
Pelamis platura, Rasumssen et al., 2011:9.

DESCRIPTION.— Body compressed, posteriorly more than twice the diameter of the neck; body scales juxtaposed, subquadrangular in shape, in 49–67 rows around thickest part of body; ventral scales, 264–406, very small and, if distinct, divided by a longitudinal groove, but usually indistin-

FIGURE 43. *Hydrophis* [*Pelamis*] *platurus* (Linnaeus, 1758). Photo courtesy of John Tashjian.

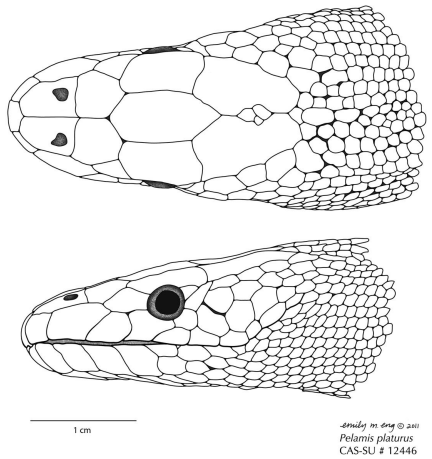


FIGURE 44. *Hydrophis* [*Pelamis*] *platurus* (Linnaeus, 1758). Illustrations by Emily M. Eng.

guishable from adjacent body scales; head narrow, snout elongate, head scales entire, nostrils superior, nasal scales in contact with one another; prefrontal in contact with 2nd upper labial; 1–2 pre- and 2–3 postoculars; 2–3 small anterior temporals; 7–8 upper labials, 4–5 below eye but separated from border by subocular; color variable but most often distinctly bicolored, black above, yellow or brown below, the dorsal and ventral colors sharply demarked from one another; ventrally there may be a series of black spots or bars on the yellow or brown background, or the yellow may extend dorsally so that there is only a narrow middorsal black stripe, or a series of black crossbars (see Smith 1943:476–477 for a more complete description of the color pattern variants).

SIZE.— Total length (♂) 720 mm, (♀) 880; tail length (♂) 80 mm, (♀) 90 mm.

DISTRIBUTION.— Philippines (widely distributed). Elsewhere: most widely distributed of all sea snakes, from east coast of Africa throughout southern and eastern coastal Asia, as far north as southern Siberia, throughout Indonesia to Australia and Tasmania, also from Gulf of Panama north to Baja California in western North America and Hawaiian Islands.

Hydrophis [*Enhydrina*] *schistosus* (Daudin, 1803)

Beaked Sea Snake; Hooked-nosed Sea Snake
Figures 20A, 21B, 22, 45

Hydrophis schistosus Daudin, 1803:386.
Enhydrina schistosa, Smith, 1926:36, fig. 17; 1943:449, fig. 144.— McCarthy, 1993:227.— David and Ineich, 1999:92.— Whitaker and Captain, 2004:390, photo (p. 391).
Disteira schistosa, McDowell, 1972:239–244.

DESCRIPTION.— Mental scale small, partly concealed within mental groove; 3–4 maxillary teeth behind fangs; 5–6 palatine teeth, palatine teeth larger than pterygoid teeth; no suborbital stripe; young light brown to dark gray above, whitish below, with dark gray or black annuli; pattern disappears in adults which are uniform gray in color; scales around body variable, in Bay of Bengal, scales around neck, (♂) 40–52, (♀) 42–55, scales around midbody, (♂) 49–60, (♀) 51–65, scales imbricate or subimbricate, with short central keel; ventrals 239–322, small, usually distinct throughout, occasionally missing on anterior part of body; precloacal scales slightly enlarged; color of young grey or bluish grey above, whitish below, with dark grey or black rings, broadest dorsally, that disappear in adults, which are usually uniformly greyish in color.

SIZE.— Total length 1400 mm; tail length 180 mm (but rarely exceeding 1100 mm total length).

DISTRIBUTION.— Philippines (although there are no specific records, its wide range and occurrence in the South China Sea in muddy bottoms of coastal waters and at the mouths of streams, makes its occurrence in the coastal waters of southwestern Philippines likely). Elsewhere: Persian/ Arabian Gulf (Iraq, Iran), Oman, Pakistan, India, Myanmar, Thailand, Malaysia, Singapore, Indonesia, east to New Guinea and Australia (David and Ineich 1999:92).

FIGURE 45. *Hydrophis* [*Enhydrina*] *schistosus* (Daudin, 1803) (inset: closeup view of head). Photos courtesy of Harold Voris.

REMARKS.— Stuebing and Inger note that "The Beaked Sea Snake is a dangerous species, with potent venom and a reputation in Peninsula Malaysia for biting fishermen. Because of its preference for muddy bottoms, it is sometimes trod upon in shallow tidal flats by people who wade barefoot while netting prawns." (Stuebing and Inger 1999:207.)

***Hydrophis semperi* Garman, 1881**

Lake Taal Sea snake
Figure 46

Hydrophis semperi Garman, 1881:85.— Smith, 1926:63.— McCarthy, 1993:240.— David and Ineich, 1999:118.

DESCRIPTION.— Head moderate, body not compressed anteriorly, greatest diameter about twice that of the neck; 6–8 maxillary teeth behind fangs; scales on body imbricate and with short keel, 29–21 around neck, 37–43 around body (increase of 10–12); ventrals 314–356, distinct throughout, bicarinate, about twice as broad as adjacent scales; precloacal scales enlarged; head black, body black with 50 to 60 narrow whitish bands of annuli, ventral scales usually black.

SIZE.— Total length (♂) 550 mm, (♀) 725; tail length (♂) 55 mm, (♀) 650 mm.

DISTRIBUTION.— Endemic to Philippines (Luzon [Prov.: Batangas{Lake Taal}]).

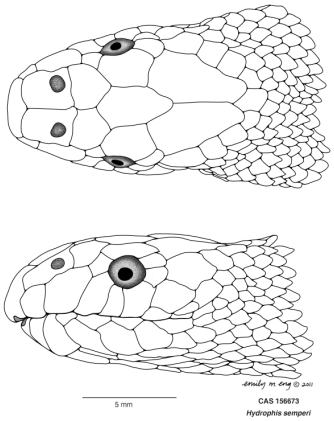


FIGURE 46. *Hydrophis semperi* Garman, 1881. Illustrations by Emily M. Eng.

***Hydrophis spiralis* (Shaw, 1802)**

Yellow Sea Snake
Figures 25A, 26C–D

Hydrus spiralis Shaw, 1802:564, pl. 125.
Hydrophis spiralis, Smith, 1926:48.

DESCRIPTION.— Head moderate, body elongate, body diameter posteriorly about twice that of neck; 6–7 maxillary teeth behind fangs; 25–31 scale rows around nexk, 33–38 at midbody, scales

feebly imbricate, smooth or with small tubercle or keel; ventrals 295–362, distinct throughout, about twice as broad as adjacent body scales; precloacal scales enlarged.

SIZE.— Total length (♂) 1620 mm, (♀) 1830; tail length (♂) 140 mm, (♀) 120 mm. (after Smith 1926:49).

DISTRIBUTION.— Philippines (a single record, juvenile, from Mergui [Smith 1926:50]) that has been repeatedly cited without further evidence of presence in Philippine coastal waters). Elsewhere: widely distributed from the Persian/Arabian Gulf east to Malaysia and Indonesia (see David and Ineich 1999:118).

Hydrophis [*Astrotia*] *stokesii* (Gray, 1846)

Malayan [or Stokes'] Sea Snake
Figures 27B, 47

Hydrus stokesii (part) Gray in Stokes, 1846:502.
Astrotia stokesi, Wall, 1909:250.
Astrotia stokesii, Smith, 1926:113.— Dunson and Minton, 1978:282.— David and Ineich, 1999:63.

DESCRIPTION.— Exceptionally thick-bodied sea snake with large head, covered by regular head scales, and thick neck, about one-half diameter of greatest diameter of body; 6 or 7 maxillary teeth behind fangs; body scales in 37–47 rows on neck, 47–59 around body, scales strongly imbricate, pointed, keeled or keels broken into tubercles; ventrals 226–286, anterior-most occasionall entire, all others divided, the two halves overlapping; color pattern, head dark olivaceous to yellowish, body yellowish to pale brown with broad black or dark brown bands or bars. (After Smith 1926:114.)

SIZE.— Total length (♂) 1200 mm, (♀) 1600 mm; tail length (♂) 170 mm, (♀) 190 mm.

DISTRIBUTION.— Philippines: South Gigante Id. (Dunson and Minton 1978:282). Elsewhere: widely distributed from India to Australia and north into the South China Sea. (See David and Ineich [1999:63] for details.)

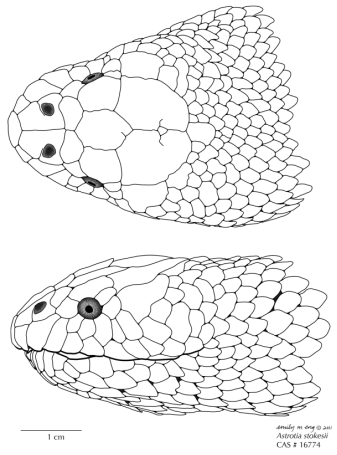


FIGURE 47. *Hydrophis stokesii* (Gray, 1846). Illustrations by Emily M. Eng.

Hydrophis [*Praescutata*] *viperinus* (Schmidt, 1852)

Grey Sea Snake

Thalassophis viperina Schmidt, 1852:79, pl. 3.
Thalassophina viperina, Smith, 1926:33.— Rasmussen, 1997:23.
Praescutata viperina, David and Ineich, 1999:177.— Stuebing and Inger, 1999:220.

DESCRIPTION.— Head short, depressed, distinct from neck; nasal scales as broad as long; prefrontals much broader than long, not in contact with upper labials; frontal twice as large as supraocular; 1 (-2) preocular, 1–2 postoculars; 7–9 upper labials, usually 3–5 bordering orbit of eye, occasionally only two border orbit; temporals variable, usually only 1, occasionally 2 or 3; 27–34 scale rows around neck; 37–50 abound midbody; ventrals 226–274, anteriorly half the width of body, posteriorly narrowed, about twice width of adjacent scales; precloacal scale enlarged.

SIZE.— Total length (♂) 925 mm, (♀) 820; tail length (♂) 100 mm, (♀) 80 mm.

DISTRIBUTION.— Philippines (not yet reported from coastal Philippine waters but present in the South China Sea and Gulf of Thailand). Elsewhere: widely distributed from Persian/Arabian

Gulf to eastern Asia, including off the coasts of northern Borneo (Sarawak), Thailand, Vietnam, China, as far north as Taiwan (see David and Ineich 1999:177, also Stuebing and Inger 1999:220), as well as eastward to northern Australia and into the western Pacific (Zug 2013:231).

Subfamily Laticaudinae

REMARKS.— The genus *Laticauda* has in recent years been assigned variously to the subfamily Elapinae, which includes cobras, kraits, and coralsnakes, and to the subfamily Hydrophiinae, the sea-snakesand Australian terrestrial elapids. Recent work by Castoe, Smith, Brown, and Parkinson (2007) provides evidence for including the genus among the subfamily of sea snakes. However, others prefer to place the genus in a separate subfamily, the Laticaudinae, within the Family Elapidae (e.g., McCarthy 1986; David and Ineich 1999).

Genus *Laticauda* Laurenti, 1768

Sea Kraits

Laticauda Laurenti, 1768:109.— David and Ineich, 1999:122.
Pseudolaticauda Kharin, 1984b:134.

DIAGNOSIS.— Maxillary bone shorter than ectopterygoid, extends forward beyond palatine; venom fangs followed by 1–3 maxillary teeth; head scales normal, large; nostrils lateral, nasals separated by internasals; body scales imbricate, smooth; ventrals large, at least half the width of body.

Laticauda colubrina (Schneider, 1799)

Yellow-lipped Sea Krait
Figures 16A, 17B, 18B, 48

Hydrus colubrinus Schneider, 1799:238.
Laticauda colubrina, Taylor, 1922a:231, pl. 29.— Smith, 1926:6; 1943:443.— McCarthy, 1993:146.— David and Ineich, 1999:123.— Whitaker and Captain, 2004:386, photo (p. 387).— Rasmussen et al., 2011:9.

FIGURE 48. *Laticauda colubrina* (Schneider, 1799) (Insert showing color markings on side of head). Photos by Cameron Siler (from Mastre de Campo Island).

DESCRIPTION.— Ventrals large, one-third to more than ½ width of body; nostrils lateral; nasals separated by internasals; an azygous prefrontal scale usually present; rostral undivided; body scales imbricate, in 21–23 longitudinal rows aboud neck, 21–25 longitudinal rows at midbody; color above light or dark bluish-grey above, yellowish below, with 24–64 black bands of more or less uniform width above and somewhat narrower than the lighter interspaces, and sometimes narrowing across the belly, head black except for a well-defined yellow horseshoe-shaped marking that originates on the snout and extends backwards beyond the eyes to the temporal region and yellow upper lips; ventrals 213–245. subcaudals paired, (♂) 37–47, (♀) 29–37.

SIZE.— Total length (♂) 875 mm, (♀) 1420 mm; tail length (♂) 130 mm, (♀) 145 mm.

DISTRIBUTION.— Philippines (Bantayan; Jolo; Luzon [Manila Bay]). Elsewhere: Smith (1943:444) states that this species is not commonly met in "Indian and Indo-Chinese waters"

though it is not uncommon at Singapore. Minton (1975: 26, Table 1) suggests that although rare in the Bay of Bengal, it may not be uncommon along the Myanmar coast and the west coast of the Malayasian Peninsula. Also coastal waters of Thailand, Malaysia, western Indonesia as far east as Polynesia and north along the east Asian coast to southern Japan.

Laticauda laticaudata (Linnaeus, 1758)

Brown-lipped Sea Krait; Black-banded Sea Krait
Figures 17A, 18A, 49

Coluber laticaudatus Linnaeus, 1758:222 (part).
Laticauda laticaudata, Taylor, 1922a:4.— Smith, 1926:4; 1943:442.— Toriba, 1993: 146.— David and Ineich, 1999:124.— Rasmussen et al., 2011:9.

DESCRIPTION.— Ventrals large, one-third to more than ½ width of body; nostrils lateral; nasals separated by internasals; 19 longitudinal rows of imbricate scales around neck and at midbody, 17 rows posteriorly; no azygous prefrontal scale; rostral undivided; body color light or dark bluish-grey above, yellowish below, with black bands of more or less uniform width throughout, each separated from the next band by 2–4 scale-row wide interspaces, head black with pale yellowish horseshoe-shaped yellow marking on snout extending along the upper sides of head to or beyond the eyes, upper lips dark brown; ventrals 225–243, subcaudals (♂) 38–47, (♀) 30–35.

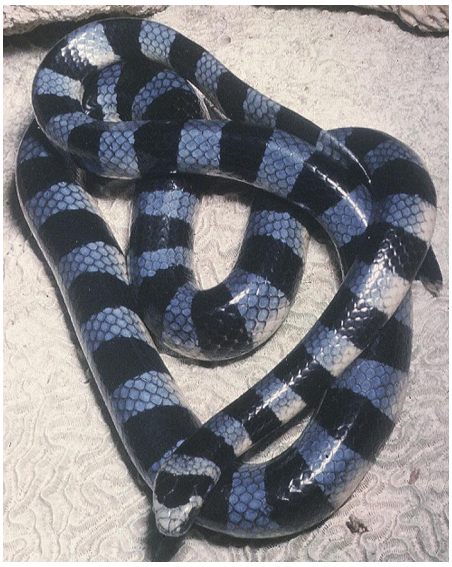


FIGURE 49. *Laticauda laticaudata* (Linnaeus, 1758). Photo courtesy of John Tashjian.

SIZE.— Total length (♂) 910 mm, (♀) 1070 mm; tail length (♂) 110 mm, (♀) 110 mm.

DISTRIBUTION.— Philippines (Bantayan; Jolo; Luzon; Mindanao; Mindoro [northern]; Samar; Sulu Id.). Elsewhere: Smith (1943:443) states that it is "rare in the Oriental region (Calcutta and Little Nicobar Harbour)." On the other hand, Minton (1975:26, table 1) suggests that although rare in the Bay of Bengal, it may not be uncommon along the west coast of the Malayasian Peninsula. Also western Indonesia (Sumatra and Java) to Australia, Melanesia and Polynesia, and north along the east coast of Asia to southern Japan.

Laticauda semifasciata (Reinwardt *in* Schlegel, 1837)

Half-banded Sea Krait

Platurus semifasciatus Reinwardt in Schlegel, 1837:516.
Laticauda semifasciata, Taylor, 1922a:234, pl. 3, fig. 2, pl. 30.— Smith, 1926:10.— David and Ineich, 1999:125.— Rasmussen et al., 2011:9.
Pseudolaticauda semifasciata, Kharin, 1984b:135.

DESCRIPTION.— Ventrals large, one-third to more than ½ width of body; nostrils lateral; nasals separated by internasals; an azygous prefrontal usually present; rostral divided by a horizontal groove; body scales imbricate, in 21–23 rows longitudinal rows at midbody; color above greenish, or bluish-grey, below yellowish, with 30–42 black bands that are broader than the lighter interspaces encircling body; head dark brown or black with a yellow curved mark above that connects

posteriorly with the yellow band at the back of the head; in older individuals, markings become less distinct; upper lip brown; ventrals 195–205; subcaudals (♂) 38–43, (♀) 32–36.

SIZE.— Total length (♂) 920 mm, (♀) 1305 mm; tail length (♂) 115 mm, (♀) 115 mm.

DISTRIBUTION.— Philippines (Luzon [Prov.: Zambales, coast of]; Negros [Prov.: Negros Oriental]; Sulu Id.). Elsewhere: China, Taiwan, Japan, Russia (*fide* David and Ineich 1999:125; Rasmussen et al. 2011:9).

Family Viperidae
Subfamily Crotalinae

Genus *Trimeresurus* Lacépède, 1804

Pitvipers

Trimeresurus Lacépède, 1804:209.

Parias Gray, 1849:11.— Malhotra and Thorpe, 2004:94–95.— David et al., 2011:43 (as a subgenus of *Trimeresurus*).

DIAGNOSIS.— Hemipenes deeply forked, spinose and papillose; first upper labial not fused to nasal scale; second upper labial fused to scale forming anterior border of facial pit; scales on head and throat smooth.

REMARKS.— Malhotra and Thorpe (2004) present substantive molecular genetic data to justify a revised taxonomy for the nominal genus *Trimeresurus* at the generic level. However, more recently, David et al. (2011:41) argue in favor of recognizing the lineages of *Trimeresurus* (*sensu lato*) as subgenera of *Trimeresurus* rather than genera as proposed by Malhotra and Thorpe (2004). At this stage of inquiry with respect to the phylogenetic relationships among the included species, we are inclined to agree with David et al. and for the reasons they state, "if one considers *Trimeresurus* as a single genus, information on the phylogenetic relationships among the various 'clades' within the genus *Trimeresurus* is obscured, but the monophyly of the main 'clade' *Trimeresurus* is emphasized with regard to other Asian (*Ovophis*, *Tropidolaemus*) and American pitviper genera. . . . It should also be emphasized that, on an external morphological basis, these subgenera are hardly diagnosable, and we think that recognizing 'genera' that cannot be diagnosed morphologically is not a help to practising taxonomists, especially when they do not have access to molecular facilities." (David et al. 2011:41.) Although we do not believe that the closing phrase is necessarily a justification for recognizing or not recognizing a taxon or clade, nonetheless, the current state of flux leads us to take a more conservative approach in handling the problem, in part so that those outside of the herpetological community, notably those in the medical profession who must deal with clinical concerns about snakebite, can more readily access information about the animals concerned.

Trimeresurus (*Parias*) *flavomaculatus* (Gray, 1842)

Yellow-spotted or Philippine Pitviper

Figures 11A, 15A–B, 50A–G

Magaera flavomaculata Gray, 1842:49.

Parias flavomaculata, Gray, 1849:11.

Trimeresurus flavomaculatus, Günther, 1879:79; Taylor, 1922a:288.— Leviton, 1964:257.— Gumprecht et al., 2004: 32, 25 col. photos (pp. 181–186).

Trimeresurus flavomaculatus flavomaculatus, Leviton, 1964:257.— Toriba, 1993:98.— David and Ineich, 1999: 284.

Trimeresurus halieus Griffin 1910:214 (Type locality: Polillo Islands).— Taylor, 1922a:286.

Trimeresurus flavomaculatus halieus, Leviton, 1964:262.— Toriba, 1993:98.— David and Ineich, 1999:284.

Trimeresurus schadenbergi Fischer, 1885:116 (Type locality: "Süd-Mindanao").

FIGURES 50A–F. Chromatic and pattern polymorphism among and within populations of *Trimeresurus* (*Parias*) *flavomaculatus* (A–B) Aurora, Luzon; (C) Zambales, Luzon; (D–F) Polillo; (G) Bicol. Photos A–F by Cameron D. Siler, G by Rafe Brown.

DESCRIPTION.— Scales on head and chin smooth or irregularly keeled; second upper labial fused to scale forming forming anterior border of facial pit; body scales in 21 longitudinal rows around midbody, 29 rows around neck; a distinct light stripe, or at least a series of light spots, present along outer scale row; dorsal color highly variable, with dark pigments present, usally blue green, green, or dark blue gray, sometimes as scattered, irregular spots or blothches, also as distinct crossbars; tail not distinctly differentiated from body by color; hemipenes without spines; ventrals (♂) 170–178, (♀) 177–182, subcaudals (♂) 62–71, (♀) 58–63.

SIZE.— Snout-vent length (♂) 614 mm, (♀) 929 mm; tail length (♂) 151 mm, (♀) 163 mm.

DISTRIBUTION.— Endemic to Philippines (Camiguin; Jolo; Leyte; Luzon [Prov.: Aurora, Bataan, Bulacan, Cagayan, Camarines Norte, Ilocos Norte, Isabela, Kalinga, Laguna, Quezon]; Mindanao [Prov.: Davao, Lanao]; Mindoro).

REMARKS.— Gumprecht et al. (2004:32) chose not to recognize *T. flavomaculatus halieus* as a subspecies and elevated *T. f. mcgregori* to the rank of full species, as do David et al. (2011:43). With respect to *T. f. halieus*, we are inclined to agree with their handling of that taxon. Indeed, recent field observations by several of the authors indicate that there is a wide range of color and pattern polymorphism both within and among populations throughout the range of the species. We also agree with the elevation of *T. mcgregori* to the rank of full species. Furthermore, recent examination of material from Mindanao suggests that the population inhabiting that island is quite distinct from Luzon *T. flavomaculatus* and should possibly be accorded recognition as a full species for which the name *T. schadenbergi* Fischer, 1885, is available. According to Gernot Vogel and Patrick David (2007:37), this matter is under investigation and the results are scheduled to appear in due course; thus we refrain from making any changes at this time.

Trimeresurus (*Parias*) *mcgregori* (Taylor, 1919)

McGregor's Pitviper

Figures 14, 51

Trimeresurus mcgregori Taylor, 1919:110.— Taylor, 1922a:284.— Gumprecht et al., 2004: 35, 18 col. photos (pp. 246–250).

Trimeresurus flavomaculatus mcgregori, Leviton, 1964:261.— Toriba, 1993:98.— David and Ineich, 1999:284.

DESCRIPTION.— Scales on head and chin smooth or irregularly keeled; second upper labial fused to scale forming forming anterior border of facial pit; a distinct light stripe, or at least a series of light spots, present along outer scale row; dorsal color yellow to greenish yellow with darker pigments forming irregular spotted patches along middorsum; tail not distinctly differentiated from body by color; hemipenes without spines.

SIZE.— Snout-vent length (♀) 587 mm; tail length (♀) 97 mm.

DISTRIBUTION.— Endemic to Philippines (Batan, Sabtang, and Cagayan Ids.).

REMARKS.— See remarks above under *T. flavomaculatus*.

FIGURE 51. *Trimeresurus* (*Parias*) *mcgregori*, color and pattern variants. Photo by Rafe Brown.

Trimeresurus (*Parias*) *schultzei* (Griffin, 1909)

Schultz's Philippine Pitviper
Figure 13

Trimeresurus schultzei Griffin, 1909:601.— Taylor, 1922a:292.— Leviton, 1964:263. Toriba, 1993:105.— David and Ineich, 1999:290.— Gumprecht et al., 2004: 37, 9 col. photos (pp. 288–289).

DESCRIPTION.— Scales on head and chin smooth or irregularly keeled; first upper labial separated from nasal by distinct suture; second upper labial fused to scale forming forming anterior border of facial pit; body scales in 21 [rarely 23] longitudinal rows at midbody; ventrals 187–203, subcaudals 66–82; a distinct light stripe, or at least a series of light spots, present along outer scale row; dorsal color greenish-brown to brown or purplish brown with 50–62 indistinct dark bars or zig-zag lines across dorsum, each 2–3 scale rows wide; a distinct yellow line along outer, ventrolateral scale row; ventrals edged with black; tail distinctly differentiated from body by its light color and without dorsal markings; hemipenes spinose.

SIZE.— Snout-vent length (♂) 706 mm, (♀) 1022 mm; tail length (♂) 162 mm, (♀) 198 mm

DISTRIBUTION.— Endemic to Philippines (Balabac; Palawan).

Genus *Tropidolaemus* Wagler, 1830

Pitvipers

Tropidolaemus Wagler, 1830:175 (Type species: *Tropidolaemus wagleri* Wagler, 1830:175).

DIAGNOSIS.— Hemipenes long, slender, deeply forked, spinose; first upper labial not fused to nasal scale; second upper labial not fused to scale forming anterior border of facial pit; scales on dorsum of head and throat strongly keeled; body scales in 19–25 longitudinal rows at midbody.

REMARKS.— See brief discussion in McDiarmid, Campbell, and Touré (1999:349), also David and Ineich (1999:294). Resurrected from the synonymy of *Trimeresurus* and then included as a subgenus by Brattstrom (1964:251), Burger (1971:109) and others but then recognized as a distinct genus following the studies of Kraus, Mink, and Brown (1996:769).

Tropidolaemus philippensis (Gray, 1842)

Philippine Temple Pitviper
Figure 52B, E–F

Trimeresurus philippensis Gray, 1842:48.— Taylor, 1922a:295, pl. 37, fig.1.
Tropidolaemus hombronii Guichenot *in* Jacquinot and Guichenot, 1853:23, pl. 2, fig. 3.
Trimeresurus wagleri, Leviton, 1964:265.
Tropidolaemus wagleri, David and Ineich, 1999:295 (doubtfully included in *T. wagleri*).
Tropidolaemus philippensis, Vogel et al., 2007:31, figs. 25–26.

DESCRIPTION.— Scales on head strongly keeled; body scales in 18–19 longitudinal rows around midbody and 19–21 around neck; scales on snout along a straight line from rostral to level of supraoculars (♂) 4–5, (♀) 5; scales on dorsum of head on line between supraoculars 6–8; ventrals 129–135, subcaudals 44–46 (49); color green-turquoise background in males, green in females; postocular stripe black, rarely white in both males and females. (After Vogel et al. 2007:31 *et seq*.)

SIZE.— Total length (♂) 455 mm; tail length (♂) 65 mm.

DISTRIBUTION.— Endemic to Philippines (Leyte; Mindanao [Prov.: Agusan Del Norte, Bukidnon, Cotabato, Davao del Sur]; Samar).

REMARKS.— *Tropidolaemus philippensis* and *T. subannulatus* were formerly included in the ubiquitous species *T. wagleri*. Recent studies have indicated that several recognizeable species

have been inappropriately parading under that nominal taxon, *T. philippensis* among them, known from Leyte, Samar, and southern and northeastern Mindanao. However, on the large and topographically diverse island of Mindanao, and on careful examination, the Zamboanga and northern Sulu (Basilan) population also appears to be quite distinct from populations inhabiting other parts of the island, although Vogel et al. (2007) had referred them to *T. philippensis*. Recent unpublished studies by the authors suggest that it may be a distinct species for which the name *T. hombronii* Guichenot *in* Jacquinot and Guichenot, 1853 (type locality, Zamboanga) is available. Thus, this taxon will have to be resurrected from the synonymy of *T. philippensis* to accommodate the Zamboanga and northern Sulu (Basilan) population. Furthermore, a recently documented population of *Tropidolaemus* found on Leyte bears a strong resemblance to *T. philippensis* (Fig. 48B) but also *T. subannulatus* (see Vogel et al. 2007:30, fig. 24 from Negros Id.). We have refrained from suggesting any changes at this time because this also is said to be under study by Vogel and David (see also remarks under *Trimeresurus flavomaculatus* and *Tropidolaemus subannulatus*).

Tropidolaemus subannulatus (Gray, 1842)

Philippine Temple Pitviper

Figures 5A–B, 11, 12A–C, 52A, C–D

Trimesurus subamnualtus Gray, 1842:48.

Trimeresurus wagleri (part), Taylor, 1922a:296.— Leviton, 1964:265.— Toribe, 1993:108.— David and Ineich, 1999:295.

Tropidolaemus wagleri (part), Burger, 1971:110.— (part) Gumprecht et al., 2004:41–42, 8 col. photos (pp. 339–340).

Tropidolaemus subannulatus, Vogel et al., 2007:23.

DESCRIPTION.— Scales on head and chin strongly keeled; internasals not in contact, separated by 2 [rarely 1] scales; scales on snout along a straight line from rostral to level of supraoculars, (♂) 4–7, (♀) 5–8; scales on dorsum of head on a line between supraoculars 9–16; 3rd upper labial usually separated from subocular scale by 1 or 2 scales; body scales in 21–23 longitudinal rows at midbody (♂), 21–29 rows (♀); ventrals (♂) 128–148, (♀) 127–147; subcaudals (♂) 45–53, (♀) 40–54; body color above, variable, green or blue in females, green in males and juveniles (but blue in some Negros populations), belly, (♀) uniform or with blue or red blotches, (♂) and juveniles uniform or with red spotting. (After Voget et al. 2007:23 *et seq*.)

SIZE.— Total length 963 mm (Snout-vent length 820 mm; tail length 143 mm.) for largest (♀)and 463 mm (Snout-vent length 384 mm; tail length 79 mm.) for largest (♂) reported by Vogel et al. (2007:23).

DISTRIBUTION.— Philippines (Balabac; Basilan; Bohol; Dinagat; Jolo; Leyte; Luzon [Prov.: Albay, Bulacan, Cavite, Cagayan, Camarines Norte, Isabela, Quezon]; Mindanao [Prov.: Agusan del Norte, Agusan del Sur, Lanao del Norte, Zamboanga]; Negros [Prov.: Negros Occidental, Negros Oriental]; Palawan; Panay; Samar, Sibutu; Tumindao; Sulu Archipelago). Elsewhere: Malaysia (Borneo [Sabah, Sarawak]); Indonesia (Belitung, Borneo [Kalimantan], Buton, Sangihe Archipelago, Sulawesi) (see Vogel et al. [2007:23, 31] for details).

REMARKS.— Given the variation observed among samples of this species studied by Vogel et al. (2007), they concluded, "We refrain from giving a more detailed description here, as the variation among this species or complex of species will be discussed in the next and forthcoming paper of the series. A splitting into several taxa seems to be likely." (Vogel et al. 2007:23.)

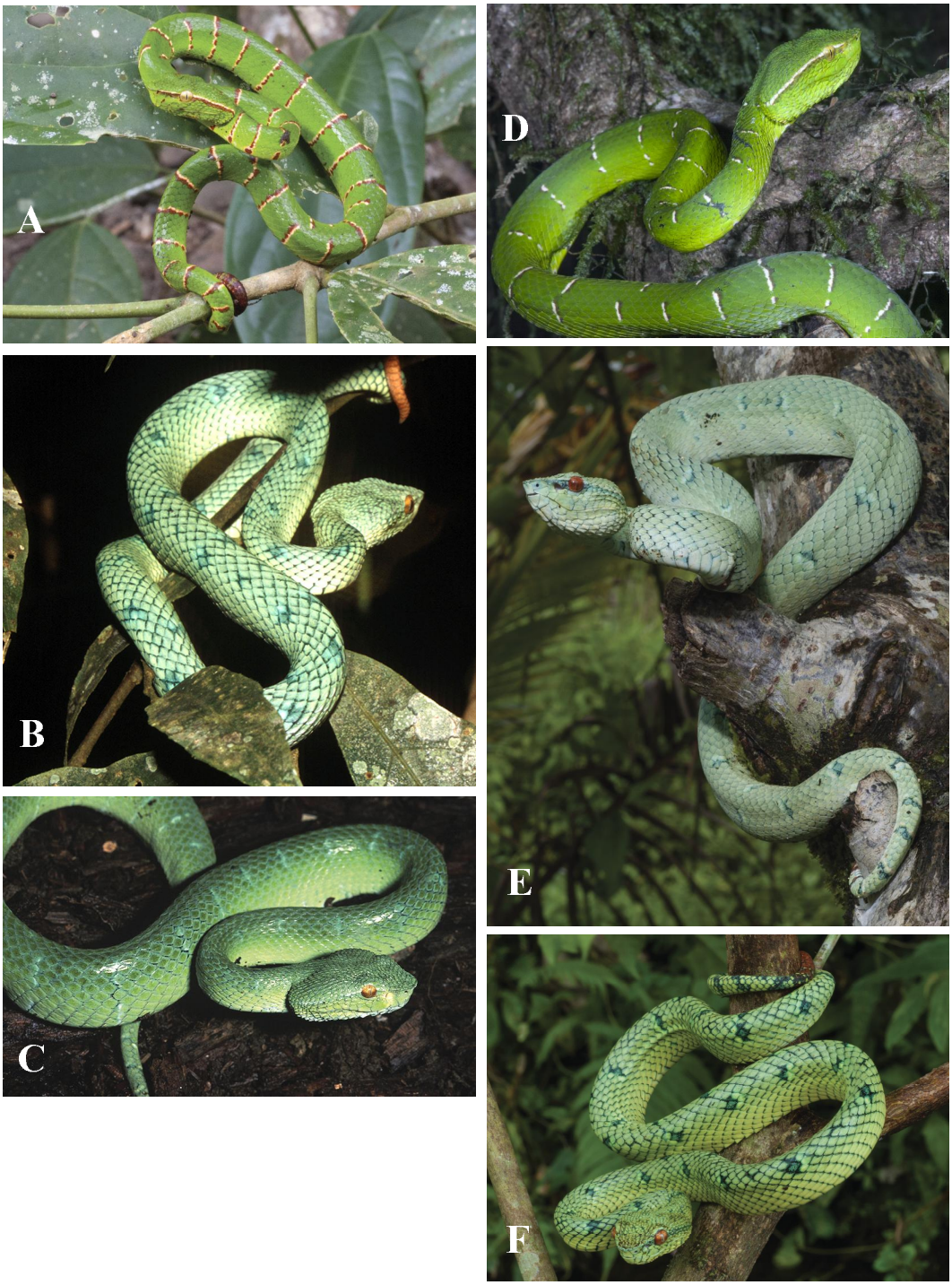


FIGURE 52. *Tropidolaemus* populations from: (A) *Tropidolaemus* cf. *subannualtus* from Makiling, Luzon (but likely a distinct species); (B) Leyte (*T. philippensis*) (but see Remarks); (C) Mt. Bulusan, Sorsogon Prov., Luzon (cf. *T. subannulatus*; female); (D) *T. subannulatus*; (E–F) Samar (*T. philippensis*). Photos A–C by Rafe Brown, D–F by Cameron D. Siler.

Selected references

ALCALA, ANGEL C. 1986a. *Guide to Philippine Flora and Fauna.* Vol. X. *Amphibians and Reptiles.* Natural Resources Management Center, Ministry of Natural Resources, and University of the Philippines, Manila, Philippines. xiv + 195.

ALCALA, ANGEL C. 1986b. *Guide to Philippine Flora and Fauna.* Vol. XII. *Poisonous Animals.* Natural Resources Management Center, Ministry of Natural Resources, and University of the Philippines, Manila, Philippines. 77–158.

BARME, MICHEL. 1967. Venomous sea snakes (Hydrophiidae). Pages 285–308 *in* W. Bucherl, et al., eds., *Venomous Animals and their Venoms*, vol. 1. Academic Press, New York, New York, USA.

BOGERT, CHARLES MITCHELL. 1945. Hamadryas pre-occupied for the king cobra. *Copeia* 1945:47.

BRATTSTROM, BAYARD H. 1964. Evolution of the pitvipers. *Transactions of the San Diego Natural History Society* 13(11):185–268.

BROADLEY, DONALD G., JEAN-CLAUDE RAGE, AND MICHICISA TORIBA. 1993. *Naja* Laurenti, 1768. Pages 184–193 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World.* Azemiops S.A., Aïre-Geneva, Switzerland.

BROWN, RAFE M. 2006. A case of suspected coral snake (*Hemibungarus calligaster*) mimicry by lepidopteran larvae (*Bracca* sp.) from Luzon Island, Philippines. *Raffles Bulletin of Zoology* 54(2):225–227, fig. 1.

BROWN, RAFE M., CARL H. OLIVEROS, CAMERON D. SILER, JASON B. FERNANDEZ, LUKE J. WELTON, PERRY ARCHIVAL C. BUENAVENTE, MAE LOWE L. DIESMOS, AND ARVIN C. DIESMOS. 2012. Amphibians and reptiles of Luzon Island (Philippines), VII: Herpetofauna of Ilocos Norte Province, northern Cordillera Mountain Range. *Checklist* 83(3):469–490, figs. 1–48, table 1.

BROWN, RAFE M., CAMERON D. SILER, CARL H. OLIVEROS, LUKE. J. WELTON, A. ROCK, J. SWAB, M. VAN WEERD, J. VAN BEIJNEN, E. JOSE, D. RODRIGUEZ, E. JOSE, AND ARVIN C. DIESMOS. 2013. The amphibians and reptiles of Luzon Island, Philippines, VIII: The herpetofauna of Cagayan and Isabela Provinces, northern Sierra Madre Mountain Range. *Zookeys* (266):1–120.

BURGER, WILLIAM LESLIE. 1971. *Genera of Pitvipers* (Serpetnes: Crotsalidae). Ph.D. thesis. University of Kansas, Lawrence , Kansas, USA. 186 pp.

CASTOE, TODD A., ERIC N. SMITH, RAFE M. BROWN, AND CHRISTOPHER L. PARKINSON. 2007. Higher-level phylogeny of Asian and American coralsnakes, their placement within the Elapidae (Squamata), and the systematic affinities of the enigmatic Asian coralsnake *Hemibungarus calligaster* (Wiegmann, 1834). *Zoological Journal of the Linnean Society* 151:809–831, figs. 1–3, tables 1–3, Appendices 1–3.

DAVID, PATRICK, AND IVAN INEICH. 1999. Les Serpents venimeux du monde: systématique et répartition. *Dumerilia* 3:3–499.

DAVID, PATRICK, GERNOT VOGEL, AND ALAIN DUBOIS. 2011. On the need to follow rigorously the Rules of the *Code* for the subsequent designation of a nucleospecies (type species) for a nominal genus which lacked one: the case of the nominal genus *Trimeresurus* Lacépède, 1804 (Reptilia: Squamata: Viperidae). *Zootaxa* (2992):1–51.

DE LEON, WALFRIDO. 1946. Cobra venom — its possibilities in Philippine medicine. *Journal of the Philippine Medical Association* 22:1–6.

DE LEON, WALFRIDO, AND ENRIQUE SALAFRANCA. 1957 [1956]. Cobra-anti-venom serum production at the Alabang Serum and Vaccine Laboratories. *Philippine Journal of Science* 85:477–487.

DERANIYAGALA, PAULUS EDWARD PIERIS. 1960. The taxonomy of the cobras of Southeastern Asia. *Spolia Zeylanica* 29:41–63, 1 fig., pls. 1–4.

DUNSON, WILLIAM A., AND SHERMAN A. MINTON, JR. 1978. Diversity, distribution, and ecology of Philippine marine snakes (Reptilia, Serpentes). *Journal of Herpetology* 12(3): 281–286.

GAULKE, MAREN, AND ALEXANDER V. ALTENBACH. 1994. Contribution to the knowledge of the snake fauna of Masbate (Philippines) (Squamata: Serpentes). *Herpetozoa* 7:63–66, fig. 1 [map]. (In English, with German abstract.)

GAULKE, MAREN, ARNOLD DEMEGILLO, JOCHEN REITER, AND BENJAMIN TACUD. 2003. Additions to the herpetofauna of Panay Island, Philippines. *Salamandra* 39:111–122, figs. 1–7.

GOLAY, PHILIPPE, HOBART M. SMITH, DONALD G. BROADLEY, JAMES R. DIXON, COLIN MCCARTHY, JEAN-

CLAUDE RAGE, BEAT SCHÄTTI, AND MICHIHISA TORIBA, EDS. 1993. *Endoglyphs and Other Major Venomous Snakes of the World: A Checklist.* Azemiops S.A. Herpetological Data Center, Aire-Geneva, Switzerland. xv + 478 pp.

GRITIS, PAUL, AND HAROLD K. VORIS. 1990. Variability and significance of parietal and ventral scales in the marine snakes of the genus *Lapemis* (Serpentes: Hydrophiidae), with coments on the occurrence of spiny scales in the genus. *Fieldiana: Zoology*, ser. New Series, i–iii, 1–13, figs. 1–4, 5–6 [maps], 7–8.

GUMPRECHT, ANDREAS. 2001. Die Bambusotter der Gattung *Trimeresurus* Lacépéde, Teil V: Die philippinischen Bambusotter Teil 1: Die Gelbflecken-Bambusotter *Trimeresurus flavomaculatus* (Gray, 1842). *Sauria* 23(3):3–14.

GUMPRECHT, ANDREAS, FRANK TILLACK, NIKOLAI L. ORLOV, ASHOK CAPTAIN, AND SERGEI RYABOV. 2004. *Asian Pitvipers.* GeiteBooks, Berlin, Germany. 368 pp. (pp. 43–354 col. photos.)

KHARIN, VLADIMIR E. 1984a. A review of sea snakes of the group *Hydrophis* sensu lato (Serpentes, Hydrophiidae). 3. The genus *Leioselasma*. *Zoologicheski'i Zhurnal* 63(10):1535–1546.

KHARIN, VLADIMIR E. 1984b. [Revision of sea snakes of subfamily Laticaudinae Cope, 1879 *sensu lato* (Hydrophiidae)]. Pages 128–139 *in* Leo Borkin, ed., *Ecology and Faunistics of Amphibians and Reptiles of the USSR and Adjacent Countries.* Trudy Zoologicheskogo Instituta, Akademia Nauk, SSSR [Proceedings of the Zoological Institute, Leningrad], vol. 124. (In Russian, with brief abstract in English.)

KHARIN, VLADIMIR E., AND J. HALLERMANN (2009): Distribution of a Little-Known Sea Krait *Pseudolaticauda schistorhynchus* (Günther, 1874) (Serpentes: Laticaudidae). *Russian Journal of Marine Biology* 35(5):437–440

KHARIN, VLADMIR E. 2005. Distribution of a little-known sea snake *Chitulia belcheri* (Gray, 1849) and new records of rare species of the genus *Leioselasma* Lacepede, 1804 (Serpentes: Hydrophiidae). *Russian Journal of Marine Biology* 31(3):159–163, figs. 1–4, tables 1–2.

KLUSMEYER, BORIS, AND BERND FAUSTEN. 1994. Haltung und Nachzucht der Bambusotter *Trimeresurus flavomaculatus halieus*. *Salamandra* 30:174–184, figs. 1–10. (In German.)

LACÉPÈDE, BERNARD GERMAIN ÉTIENNE. 1804. Mémoire. Sur plusieurs animaux de la Nouvelle Hollande dont la description n'a pas encore eté publiée. *Ann. Mus. Paris* 4:197.

LEVITON, ALAN EDWARD. 1961. Keys to the dangerously venomous terrestrial snakes of the Philippine Islands. *Silliman Journal* 8:98–106, figs. 1–2.

LEVITON, ALAN EDWARD. 1964 [1963]. Contributions to a review of Philippine snakes, III. The snakes of the genera *Maticora* and *Calliophis*. *Philippine Journal of Science* 92:523–550, fig. 1 [map].

LEVITON, ALAN EDWARD. 1964. Contributions to a review of Philippine snakes, V. The snakes of the genus *Trimeresurus*. *Philippine Journal of Science* 93:251–276, figs. 1–2 [maps].

LEVITON, ALAN EDWARD. (1968). The venomous terrestrial snakes of East Asia, India, Malaya, and Indonesia. Pages 529–576 *in* Wolfgang Bücherl, Eleanor E. Buckley, and Venancio Deulofeu, eds., *Venomous Animals and their Venoms*, vol. 1, *Venomous Vertebrates*, Chap. 18. Academic Press, New York, New York, USA.

LUKOSCHEK, VIMOKSALEHI, AND J. SCOTT KEOGH. 2006. Molecular phylogeny of sea snakes reveals a rapidly diverged adaptive radiation. *Biological Journal of the Linnean Society* 89:523–539, figs. 1–3, tables 1–3, Appendix.

LUTZ, MARIO. 2006. Die Kobras des Philippinischen Archipels. Teil I: Die Philippinen-Kobra, *Naja philippinensis* Taylor, 1922. *Sauria* 28:5–11, figs. 1–10 (col.). (In German.)

MALHOTRA, ANITA, AND ROGER S. THORPE. 2004. The phylogeny of four mitochondrial gene regions suggests a revised taxonomy for Asian pitvipers (*Trimeresurus* and *Ovophis*). *Molecular Phylogenetics and Evolution* 32:83–100.

MCCARTHY, COLIN J. 1993. *Laticauda* Laurenti, 1768. Pages 145–148 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World*. Azemiops S.A., Aïre-Geneva, Switzerland.

MCCARTHY, COLIN J. 1993. *Acalyptophis* Boulenger, 1896. Pages 221 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World*. Azemiops S.A., Aïre-Geneva, Switzerland.

MCCARTHY, COLIN J. 993. *Aipysurus* Lacepede, 1804. Pages 221–224 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World*. Azemiops S.A., Aïre-Geneva, Switzerland.

MCCARTHY, COLIN J. 1993. *Astrotia* Fischer, 1855. Pages 224–225 *in* Philippe Golay et al., eds., *Endoglyphs*

and other Major Venomous Snakes of the World. Azemiops S.A., Aïre-Geneva, Switzerland.

McCARTHY, COLIN J. 1993. *Enhydrina* Gray, 1849. Pages 227–228 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World*. Azemiops S.A., Aïre-Geneva, Switzerland.

McCARTHY, COLIN J. 1993. *Hydrophis* Latrielle 1801. Pages 229–242 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World*. Azemiops S.A., Aïre-Geneva, Switzerland.

McCARTHY, COLIN J. 1993. *Lapemis* Gray, 1834. Pages 243–245 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World*. Azemiops S.A., Aïre-Geneva, Switzerland.

McCARTHY, COLIN J. 1993. *Pelamis* Gray, 1834. Pages 245–247 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World*. Azemiops S.A., Aïre-Geneva, Switzerland.

McCARTHY, COLIN J., AND DAVID A. WARRELL. 1991. A collection of sea snakes from Thailand with new records of *Hydrophis belcheri* (Gray). *Bulletin of the British Museum of Natural History., Zoology* 57(2): 161–166.

McCOY, C. J., AND DONALD E. HAHN. 1979. The yellow-bellied sea snake, *Pelamis platurus* (Reptilia: Hydrophiidae), in the Philippines. *Annals of the Carnegie Museum* 48:231–234.

McDIARMID, ROY W., JONATHAN A. CAMPBELL, AND T'SHAKA A. TOURÉ. 1999. *Snake Species of the World. A Taxonomic and Geographic Reference*, Vol. 1. Herpetologists' League, Washington, DC. xi + 511 pp.

McDOWELL JR., SAMUEL BOOKER. 1972. The genera of sea-snakes of the *Hydrophis* group (Serpentes: Elapidae). *Transactions of the Zoological Society of London* (32):189–247, 1 fig.

MINTON JR., SHERMAN A. 1975. Geographic distribution of sea snakes. Pages 21–31 *in* William A. Dunson, *The Biology of Sea Snakes*. University Park Press, Baltimore, Maryland, USA.

MINTON JR., SHERMAN A. 1978. Serological relations of some Philippine sea snakes. *Copeia* 1978:151–154.

MINTON JR., SHERMAN A., AND MILTON S. DA COSTA. 1975. Geographic distribution of sea snakes. Pages 33–55 *in* William A. Dunson, *The Biology of Sea Snakes*. University Park Press, Baltimore, Maryland, USA.

MITTLEMAN, M. B. 1947. Geographic variation in the sea snake *Hydrophis ornatus* (Gray). *Proceedings of the Biological Society of Washington* 60:1–8.

POPE, CLIFFORD HILLHOUSE, AND SARAH HAYDOCK DAVIS POPE. 1933. A study of the green pit vipers of S. E. Asia and Malaysia, commonly identified as *Trimeresurus gramineus* (Shaw), with description of a new species from Peninsula India. *American Museum Novitates* :1–12.

PYRON, R. ALEXANDER, FRANK T. BURBRINK, AND JOHN J. WIENS. 2013. A phylogeny and revised classification of Squamata, including 4161 species of lizards and snakes. *BMC Evolutionary Biology* 13(93):1–53, figs. 1–28. (<*http://www.biomedcentral.com/1471-2148/13/93*>)

RASMUSSEN, ARNE REDSTED. 1989. An analysis of *Hydrophis ornatus* (Gray), *H. lamberti* Smith, and *H. inornatus* (Gray) (Hydrophiidae, Serpentes) based on samples from localities, with remarks on feeding and breeding biology of *H. ornatus*. *Amphibia-Reptilia* 10:397–417, figs. 1–12.

RASMUSSEN, ARNE REDSTED. 1997. Systematics of sea snakes: a critical review. Pages 15–30 *in* R.S. Thorpe, W. Wüster, and A. Malhotra, eds., *Venomous snakes: Ecology, Evolution and Snakebite*. Clarendon Press, Zoological Society of London & Oxford, London, UK. Symp. Zool. Soc. London, vol. 70.

RASMUSSEN, ARNE REDSTED. 2001. Sea snakes. Pages 3987–4008 *in* K.E. Carpenter and V.H. Niem, eds., *The Living Marine Resources of the Western Pacific*. Vol. 6. *Bony fishes part 4* (*Labridae to Latimeriidae*), *estuarine crocodiles, sea turtles, sea snakes and marine mammals*. FAO Species Identification Guide for Fishery Purposes. Rome, Italy: Food and Agriculture Organization of the United Nations.

RASMUSSEN, ARNE REDSTED. 2002. Phylogenetic analysis of the "true" aquatic elapid snakes Hydrophiinae (*sensu* Smith et al., 1977) indicates two independent radiations into water. *Steenstrupia* 27(1):47–63, figs. 1–3.

RASMUSSEN, ARNE REDSTED, JOHAN ELMBERG, PETER GRAVLUND, AND IVAN INEICH. 2011. Sea snakes (Serpentes: subfamilies Hydrophiinae and Laticaudinae) in Vietnam: a comprehensive checklist and an updated identification key. *Zootaxa* (2894):1–20, figs. 1–9.

RASMUSSEN, ARNE REDSTED, AND IVAN INEICH. 2010. Species diversity in the genus *Emydocephalus* Kreft, 1869 (Serpentes, Elapidae, Hydrophiinae): Insight from morphology and anatomy. *Herpetological Review* 41:285–290.

REID, H. ALISTAIR. 1975. Epidemiology and clinical aspects of sea snakebites. Pages 417–462 *in* William A. Dunson, *The Biology of Sea Snakes*. University Park Press, Baltimore, Maryland, USA.

REYES, A. C., AND C. LAMANA. 1955. Snakebite mortality in the Philippines. *Philippine Journal of Science* 84:189–194.

SANDERS, KATE L., MICHAEL S. Y. LEE, MUMPUNI, TERRY BERTOZZI, AND ARNE R. RASMUSSEN. 2013. Multilocus phylogeny and recent rapid radiation of the viviparous sea snakes (Elapidae: Hydrophiinae). *Molecular Phylogenetics and Evolution* 66(2013):575–591, figs. 1–4, table 1, Appendices A and B.

SAWAI, Y., K. KOBA, T. OKONOGI, S. MISHIMA, Y. KAWAMURA, H. CHINZEI, ABU BAKAR BIN IBRAHIM, T. DEVARAJ, SRIPRAPAI PHONG-AKSARA, CHALOEM PURANANANDA, E. S. SALAFRANCA, J. S. SUMPAICO, C. S. TSENG, J. F. TAYLOR, C. S. WU, AND T. P. KUO. 1971. An epidemiological study of snakebites in the Southeast Asia. *The Snake* 3:97–128, figs. 1–17, maps 1–7, 28 tables.

SCHÄTTI, BEAT, AND MICHEL GUILLOD. 1990. Bemerkungen zur Rassengliederung bei der Philippinischen Bambusotter, *Trimeresurus flavomaculatus* (Gray, 1842). *Herpetofauna* (*Weinstadt*) 12:32–34. (In German, with English summary.)

SILER, CAMERON D., AND LUKE J. WELTON. 2010. Geographic variation in Philippine mimicry system: hypothesized widespread coral snake (*Hemibungarus calligaster*) mimicry by lepidopteran larvae (*Bracca* sp.) on Luzon Island, Philippines. *Herpetological Review* 41(4):427–430, figs. 1–2.

SILER, CAMERON D., LUKE J. WELTON, J. M. SILER, J. BROWN, A. BUCOL, ARVIN C. DIESMOS, AND RAFE M. BROWN. 2011. Amphibians and reptiles, Luzon Island, Aurora Province and Aurora Memorial National Park, Northern Philippines: New island distribution records. *Check List* 7:182–195.

SILER, CAMERON D., J. C. SWAB, C. H. OLIVEROS, ARVIN C. DIESMOS, L. AVERIA, A. C. ALCALA, AND RAFE M. BROWN. 2012. Amphibians and reptiles, Romblon Island Group, central Philippines: Comprehensive herpetofaunal inventory. *Check List* 8:443–462.

SLOWINSKI, JOSEPH BRUNO, JEFF BOUNDY, AND ROBIN LAWSON. 2001. The phylogenetic relationships of Asian coral snakes (Elapidae: *Calliophis* and *Maticora based on morphological and molecular characters.* Herpetologica 57:233–245, figs. 1–5.

SMITH, MALCOLM ARTHUR. 1926. *Monograph of the Sea-Snakes* (*Hydrophiidae*). Trustees of the British Museum, London, UK. xx + 130 pp., figs. 1–35, pls. 1–2.

STEJNEGER, LEONHARD. 1907. Herpetology of Japan and Adjacent Territories. *Bulletin of the United States National Museum* 58:xx + 577 pp., 35 pls.

STUEBING, ROBERT B., AND ROBERT F. INGER. 1999. A Field Guide to the Snakes of Borneo. Natural History Publications (Borneo), Kota Kinabalu, Sabah, Malaysia. viii + 254 + [2], illus. [col. photos.].

SWEENY, R. 1994. McGregor's pit viper, *Trimeresurus flavomaculatus mcgregori*. *Herptile* 19:71, 86–88, pl. (p. 71).

TAYLOR, EDWARD HARRISON. 1922a. *The Snakes of the Philippine Islands. Bureau of Science, Manila,* Publication no. 16. Bureau of Science, Manila, Philippines. 312 pp., pls. 1–37.

TAYLOR, EDWARD HARRISON. 1922b. Additions to the herpetological fauna of the Philippine Islands, II. *Philippine Journal of Science* D 21(3, September):257–302, pls. 1–4.

TAYLOR, EDWARD HARRISON. 1922c. Herpetological fauna of Mount Makiling. *Philippine Agriculture* 11(5, December):127–139.

TAYLOR, EDWARD HARRISON. 1923. Additions to the herpetological fauna of the Philippine Islands, III. *Philippine Journal of Science* 22:515–555, pls. 1–3.

TORIBA, MICHISICA. 1990. Venomous snakes of medical importance in the Philippines. Pages 463–469 *in* P. Gopalakrishnakone, et al., eds., *Snakes of Medical Importance (Asia-Pacific Region)*. (Includes col. figs. 1–3.) National University of Singapore and International Society on Toxicology (Asia-Pacific Section), Singapore.

TORIBA, MICHICISA. 1993. *Tropidolaemus* Wagler, 1830. Pages 108–109 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World.* Azemiops S.A., Aïre-Geneva, Switzerland.

TORIBA, MICHICISA. 1993. *Calliophis* Gray, 1834. Pages 123–124 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World.* Azemiops S.A., Aïre-Geneva, Switzerland.

TORIBA, MICHICISA. 1993. *Hemibungarus* W. Peters, 1862. Pages 139–143 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World.* Azemiops S.A., Aïre-Geneva, Switzerland.

TORIBA, MICHICISA. 1993. *Maticora* Gray, 1834. Pages 150–154 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World.* Azemiops S.A., Aïre-Geneva, Switzerland.

TORIBA, MICHICISA. 1993. *Ophiophagus* Günther, 1864. Pages 195–196 *in* Philippe Golay et al., eds., *Endoglyphs and other Major Venomous Snakes of the World*. Azemiops S.A., Aïre-Geneva, Switzerland.

VICK, JAMES A., JURGEN VON BREDOW, MARIE M. GRENAN, AND GEORGE M. PICKWELL. 1975. Sea snake antivenin and experimental envenomation therapy. Pages463–485 *in* William A. Dunson, *The Biology of Sea Snakes*. University Park Press, Baltimore, Maryland, USA.

VOGEL, GERNOT, PATRICK DAVID, MARIO LUTZ, JOHAN VAN ROOIJEN, AND NICHOLAS VIDAL. 2007. Revision of the *Tropidolaemus wagleri*-complex (Serpentes: Viperidae: Crotalinae). I. Definition of included taxa and redescription of *Tropidolaemus wagleri* (Boie, 1827). *Zootaxa* (1644):1–40, figs. 1–30, tables 1–7.

VOGTMAN, DONALD B. 1950. The relative efficiency of two types of anti-venom sera in neutralizing cobra venom. *Copeia* 1950:225–228.

VORIS, HAROLD K. 1977. A phylogeny of the sea snakes (Hydrophiidae). *Fieldiana: Zoology* 70:79–166.

VORIS, HAROLD K., AND HEATHER H. VORIS. 1983. Feeding strategies in marine snakes: an analysis of evolutionary, morphological, behavioral and ecological relationships. *American Zoology* 23:411–425.

WALL, FRANK. 1909. A monograph of the sea snakes. *Memoirs of the Asiatic Society of Bengal* 2(8):250.

WALL, FRANK. 1924. The hamadryad or king cobra, *Naia hannah* (Cangtor). *Journal of the Bombay Natural History Society* 30:189–195, 1 pl.

WATT, GEORGE, AND R. DAVID G. THEAKSON. 1985. Seasnakebites in a freshwater lake. *American Journal of Tropical Medicine and Hygiene* 34:770–773.

WEGNER, A. M. R. 1954. The snakes of the genus *Maticora* Gray with special reference to *Maticora bivirgata bivirgata* (Boie) and *M. intestinalis intestinalis* (Laurenti). *Penggemar Alam* 34:55–58.

WÜSTER, WOLFGANG. 1996. Taxonomic changes and toxinology: systematic revisions of the Asiatic cobras (*Naja naja* species complex). *Toxicon* 34:399–406.

WÜSTER, WOLFGANG, AND ROGER S. THORPE. 1989. Population affinities of the Asiatic cobra (*Naja naja*) species complex in south-east Asia: Reliability and random resampling. *Linnean Society of London, Biological Journal* 36:391–409.

WÜSTER, WOLFGANG, AND ROGER S. THORPE. 1990. Systematics and biogeography of the Asiatic cobra (*Naja naja*) species complex in the Philippines. Pages 333–344 *in* Gustav Peters and Tainer Hutterer, eds., *Vertebrates in the Tropics. Proceedings of the International Symposium on Vertebrate Biogeography and Systematics in the Tropics, Bonn, June 5–8, 1989*. Alexander Koenig Zoological Research Institute and Zoological Museum, Bonn, Bonn, Germany.

WÜSTER, WOLFGANG, AND ROGER S. THORPE. 1991. Asiatic cobras: Systematics and snakebite. *Experimentia (Basel)* 47:205–209.

WÜSTER, WOLFGANG, AND ROGER S. THORPE. 1992. Dentitional phenomena in cobras revisited: spitting and fang structure in Asiatic species of *Naja* (Serpentes: Elapidae). *Herpetologica* 48:424–434.

ZUG, GEORGE R. 2013. *Reptiles and Amphibians of the Pacific Islands*. University of California Press, Berkeley, California, USA. x + 306 pp., text figs. 1–30, pls. 1–35.

APPENDIX A

Glossary

See also diagrams of head and body scalation in a typical snake on page 8
For additional terms, see Peters, James A. 1964. *Dictionary of Herpetology*. Hafner Publ. Co., New York. vii + (1) + 362 + (30 pp. figs.)

anal plate: (see precloacal scale).

a**nterior**: in front or toward the front; the head as the most anterior portion of the body [its opposite, posterior {*q.v.*}].

arboreal: inhabiting or frequenting trees, including animals that spend at least part of the time in trees or high bushes.

azygous: not one of a pair; a single scale, usually on the midline as a single, median head scale.

body scale rows: see scale rows (body).

caudal: tail.

clade: a group of phylogenetically related organisms that is defined by features exclusive to all its members and that distinguish the group from all others.

cloaca: chamber just anterior to the base of the tail; it receives all digestive, excretory, and reproductive materials prior to their exit to the outside through the vent.

distal: away from; behind the point of origin or attachment; e.g., behind and away from the front end or head region measured from a refernce point that is more forward.

dorsal (above): toward the back or upper side of head or body [its opposite, ventral {*q.v.*}].

dorsum: the back or upper side of body.

hemipenis (plural, hemipenes): one of a pair of male copulatory organs; at rest, the hemipenes are stored in a cavity in the tail; during copulation, only one is everted; it appears like a bulbous finger of a glove, is often highly ornamented organ, and protrudes from the vent opening.

imbricate: overlapping [as opposed to juxtaposed {*q.v.*}], when one scale overlaps the one immediately behind. [its opposite, juxtaposed {*q.v.*}].

juxtaposed: placed side by side, not overlapping [its opposite, imbricate {*q.v.*}].

keels: raised elongate ridges on scales, usually in median position on head and/or body scales.

labial scales: scales bordering the lips of the mouth, those bordering the upper lip are upper or supralabials, the lower lip, lower, sub- or infralabials.

lateral: the side.

longitudinal: entending along the long axis of the body, from head to tail.

loreal scale: a scale on the side of the head placed between the eye and the nostril; usually separated from the anterior border of the eye orbit by a preocular scale [*q.v.*], which may be divided by a horizontal grove into two scales, and from the nostril by the posterior portion of the nasal scale [*q.v.*]; in the absence of a loreal scale, the nasal and preocular scales are in contact with one another.

nasal scale(s): scale pierced by the nostril; scale may be divided by a suture into anterior and posterior segments.

occipital scale(s): usually a pair of enlarged scales at the rear end of the head behind the enlarged parietal scales [*q.v.*]; occasionally a single, small scale partially inserted betwen the parietals along their posterior edge or several small scales bordering the parietals behind.

parietal scales: a pair of enlarged scales on the posterior part of the dorsum of the head, usually the last of the enlarged head scales.

posterior: behind or toward the rear [its opposite, anterior {*q.v.*}].

postocular scale(s): one or more scales that border the back edge of the eye orbit.

precloacal scale (often termed anal scale or plate): enlarged scale following last ventral scale that overlies the cloacal or vent opening; scale may be single or paired.

preocular scale: one or more scales that border the front edge of the eye orbit (but see also loreal scale above).

proximal: next to or nearest to point of origin or attachment; toward the front end or head region from a refernce point that farther behind.

scales, scutes, shields: frequently used interchangeably. However, scutes and shields are usually larger structures than scales, which term is most often used to described the smaller structure that adorn the dorsum of the body. Scutes and shields are terms usually reserved to describe the belly scales as well as the scales on the head and chin. To avoid confusion, we have used the term scale(s) to describe all the epidermal structures on the snakes.

scale rows (body): scales on the upper and sides of the body, usually arranged in parallel longtiudinal rows; the number of transverse rows (rows across the body) are counted beginning with the first row on the side that is in contact with the enlarged ventrals and counting to the opposite side.

sensory pit: a deep depression on the side of the head between the nostril and the eye of some viperine snakes (pitvipers) that contains an infrared (heat) sensory receptor at its base; in pitvipers the pit occurs on each side in the loreal scale.

snout-vent length: straight-line distance measured from the tip of snout to the posterior edge of the anal orifice.

subcaudal scales: enlarged plate-like scales on the underside of the tail, usually paired but occasionally undivided.

subocular scale(s): one or more scales lying between eye and upper labial scales [*q.v.*].

tail length: straight-line distance measured from the vent to the tip of the tail.

temporal scales: scales on the sides of the head behind the eye and the postocular scale.

total length: straight-line distance from the front of the snout to the tip of the tail.

transverse (across): set crosswise, at right angles to the longitudinal or long axis of the body, extending from side to side.

vent: opening of the cloaca to the outside, covered by an enlarged precloacal scale [*q.v.*].

ventral (below): ventrum, underside, or toward the underside (see also ventral scales).

ventral scales: transversely enlarged plate-like scales on the underside of the trunk extending from the throat to the precloacal scale; among sea snakes, sometimes indistinguishable from adjacent scales.

ventrolateral: a narrow region along the lower side where ventrum and side of trunk meet.

ventrum: underside of trunk from neck to vent.

APPENDIX B: INDEX TO SCIENTIFIC NAMES

(Images appear on pages that are boldfaced)

Appendix C: Index to Common English Names